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ALTERNATING CURRENT ARCS.

Although the subject of the relative efficiency of the alternating and the continuous current arc has already been well threshed, some results just published obtained by Dr. Fleming some years ago, may still be of interest. In a paper abstracted in the Digest this week he showed from experiments that for the same number of watts in the arc the spherical candle-power of the continuous current arc is to that of the alternating current arc as 3 to 2, but that if the quantity of light directly available for lighting a floor space be taken into account, then the efficiencies are in the ratio of 6 to 2. This is of course only one factor in determining the relative commercial values of the two lights, and it loses most of its importance in the case of parallel distribution so common abroad, in which the continuous current arcs must have a dead resistance in series with them absorbing as high as 30 per cent. of the energy, while for alternating arcs the voltage is transformed down to that required by the lamp. But that the matter is of importance is shown by the fact that in England rectifiers are becoming more and more prominent when arc lights are run from alternating current circuits. While in many cases it may be an advantage to supply an arc light from incandescent light mains, as a rule we think the American practice of running arc lights in series on separate arc light circuits, is the best, at least for street lighting, and when the lights burnfor a certain definite period and are not scattered too much.

THE INCANDESCENT LAMP PATENT.

On November 17 the Canadian Edison Incandescent lamp patent expires and simultaneously the United States patent on the same invention comes to an end, its life being limited by that of the former patent through having been issued in Canada prior to the date of the United States issue. There is, it is true, a chance that its life may be revived in this country by a reversal of the present law in the Bate Refrigerator case, argued before the United States Supreme Court this week, but such an eventuality is pronounced by those well qualified to express an opinion on the subject as extremely improbable. Should such a reversal, however, be made, the patent, of course, during the intervening period is nul, and the art free to all. It would not seem possible that anyone manufacturing during that period could thereby be subjected to any claim for an accounting of profits, though he might be compelled to cease manufacturing after the decision, and even this, in view of the past history of patent litigation, cannot be too confidently asserted. There will doubtless occur to many in connection with the expiration of the incandescent lamp patent, reflections in regard to the uncertainty of the protection afforded by our patent laws. Though one of the most important inventions ever made, and notwithstanding the support eventually accorded by the courts and an annual demand for the commodity manufactured under it, which, before the date of expiration, had entered the millions, it is nevertheless true that little if any money has been made from the lamp patent, while much has been lost by investors through a misplaced faith in our much-lauded, though eminently uncertain, patent system.

THE RECENT ELECTIONS.

We print elsewhere in this issue the views of a large number of business men connected with the electrical and allied trades in regard to the business effect of the recent elections. As will be seen, the concensus of opinon is that the result will lead to an early amelioration of business conditions, with a probability of the good effect extending over several years at least. While political faith is doubtless a factor in some of the opinions expressed, yet there must be a basis of fact to account for the substantial unanimity of opinion held, for business men as a rule are too hard headed to

let their political beliefs run away with their business judgment. That the tariff question, though not directly at issue, was a large factor in some localities, is undoubted. Aside from this, however, was the intense dissatisfaction at the manner in which the business interests of the entire country were kept in suspense for months while the Senate was squabbling over the silver and tariff bills. It is but natural that the deplorable tactics of delay then pursued, regardless of the destructive effect of this delay on the business interests of the entire country, should have exasperated even the stoutest of partisans, and when with this was coupled the suspicion that corrupt motives were also involved, it is not at all surprising that there should follow such an overwhelming rebuke as that just administered. With those driven from power who had to bear the responsibility for this state of affairs, and with the party which has succeeded in no position, for several years, at least, to reopen the questions which produced such demoralization, there is every assurance that we shall now enjoy the stable conditions so necessary to commercial prosperity. Nothing is to be so sincerely regretted as the demoralizing effect which partisan or corrupt politics may have on the business interests of the country, and it is to be hoped that the severe chastisement of November 6th will have a beneficial effect for years to come.

COLD LIGHT.

In connection with Prof. Ebert's recent paper, which, since we called attention to it, has been published in many other electrical journals,—we remarked editorially in our issue of October 6th, that the light efficiency of an incandescent lamp was stated by others to be about 5 per cent. "from which it would appear that the greatest possible efficiency that can be expected is twenty times as great as that of the incandescent lamp, assuming that the 5 per cent. which is now converted into light, is converted as efficiently as it is in the cold phosphorescent lights." Our intention in making this remark was to call attention to an apparent discrepancy between this usually accepted statement and the enormously greater efficiency which Ebert claims is possible. He claims to have obtained about one-fortieth of a candle from one-millionth of a watt, or at the rate of one candle for one twenty-five thousandths of a watt, which is about seventy-five thousand times the watt efficiency of the present incandescent lamp. The idea that a central station would be able to supply 75,000 lamps in place of every one lamp at present, with the same quantity of coal, is certainly very startling and seems almost incredible. It follows from this, that either the supposed 5 per cent. efficiency of our present lamp is wrong or else Prof. Ebert is mistaken, or probably both. Dr. Bell, in a communication to us, assumes that the 5 per cent. is correct and concludes that "either Ebert's figures are enormously wrong or else his light is derived, not from the transformation of electrical energy, but from the potential energy of the luminescent substance, in which case the apparatus becomes a species of modified candle instead of an electric lamp." His conclusions would seem to be correct provided his assumption is not wrong, but is it beyond dispute that the light efficiency of an incandescent lamp is as high as 5 per cent.? Such high authorities as Tesla, and we believe Prof. Langley, also, have made statements that show that this 5 per cent. is far too high. The energy converted into light in an incandescent lamp was measured, we believe, by the difference between two nearly equal quantities, but every physicist and chemist will doubtless agree with us that such a method of measurement is the worst possible and is used only when there is no other way. With all due respect to those who have measured the light efficiency of the incandescent lamp, the results are so contrary to statements made by such authorities as Tesla, Ebert, Langley and others, that they cannot be accepted. We trust that this, which forms a part of one of the two most important problems of the present day, will receive the attention of the highest authorities and be fully discussed. We will be only too glad to give space in our columns to any one who can contribute any knowledge to this most important subject.

PHOTOMETRIC SYMBOLS.

As our readers well know, we have taken an active part—more so than any other journal, except perhaps L'Industrie Electrique—in endeavoring to introduce the much needed uniformity in electrical symbols, terms and definitions. Several years ago, when the American Institute's Congress proposals were discussed, we published a very complete report of the criticisms made abroad. Besides publishing Hospitalier's excellent table, both as originally proposed and as subsequently revised, we have also given reports of all discussions of terms and symbols which have been proposed since the meeting of the Congress. Among the latter there were besides the term reactance, a much needed set of photometric units, proposed by Prof. Blondel, a full report of which was published in the Digest and discussed editorially. Judging from the fact that his proposals, with one exception, have not brought forth any adverse criticisms, and as they have been published for some time, it may now be safely assumed that they are generally accepted. Probably there will be some chronic late comers, as there were in the case of the Congress proposals, who wait until it is too late and then come forth with objections against what the majority have accepted, but as they have not taken the trouble to give their opinions when asked to do so, their criticisms and suggestions need not be considered. In this we refer to the classification and the terms of the photometric quantities. The subject of the names, the values of the units and the symbols of the quantities, are still open for discussion. Mr. Hospitalier, that ardent, clear-minded and indefatigable advocate of a uniform system of units, terms and symbols, has just suggested a set of symbols for these photometric quantities. They are given in the Digest this week and consist of the initial letters of the French terms, represented by bold-faced type, such as was formerly used for some of the magnetic units. By chance these initial letters are all different in the French language, while in the English and German most of them are L and many I. While he expresses himself as quite willing to have chosen the initial letters from other languages, he gives this as a reason for not doing so. It seems to us that the argument is a good one and as we can see no objection to his proposals, we are willing to advocate these symbols and introduce them into our columns, unless in the discussion which we hope will follow, sufficiently good reasons are given to change our present opinion. An examination will show that these initial letters represent the initials of the English terms as well as the French, if we take the principal word in the term, that is, the noun, and in one case "quantity of light" **Q** instead of **L**, which already represents "lumination." There is only one exception to this, the **E** (eclairement) for "illumination." While this single exception is an unfortunate one, especially as it is an important quantity, yet it will be no more than due reciprocity to accept it, as the French have changed another term to suit English speaking people. One fortunate feature in his proposals is that these letters do not include either **B** or **H** and it therefore cannot be argued that they may be confused with the now obsolete symbols for these well-known magnetic units, for which the last Congress has recommended the French script letters, which recommendation is being generally accepted, except by some English writers and journals who still resist the introduction of international uniformity, as they have and do in the case of their wretched system of weights and measures, which we Americans have unfortunately inherited from them. We trust that those of our readers who are interested in these symbols will discuss the matter now or forever after hold their peace.

The Bate Refrigerator Case.

The briefs have been filed in the United States Supreme Court on both sides of the Bate Refrigerator case, and it now awaits argument. When last called for hearing Justice White was absent, and, owing to the importance of the case, the court decided to postpone the hearing until the entire bench is present. Nov. 12 was agreed upon by the Court and Council, but the case may not be reached until Nov. 14.

A General Theory of the Incandescent Lamp.

The last two numbers of the "Physical Review" contain a translation by Prof. E. L. Nichols of a valuable paper by Prof. H. S. Weber, read before the Frankfort Congress for Elektrotechnics, which gives a general mathematical theory of the incandescent lamp.

It is stated that the simplicity of the conditions existing in the production of light from the incandescent lamp are such as to lead to the supposition that between the size and temperature of the radiating surface, the wave length and intensity of radiation and the quantities by means of which the electrical energy developed in the filament are determined, there exist relations which are capable of expression in some simple form. Former investigations are criticized for the reason that the most important element—temperature of the filament—was left altogether out of account, and it was to the determination of this that Prof. Weber first applied himself, making for this purpose exact measurements upon more than 30 types of lamps. He states that he believes he has now reached a point where the phenomena of incandescent lamps may be expressed by means of a few formulæ.

The starting point of the investigation was the establishment of a general expression by means of which the intensity of homogenous radiations of a given wave length emitted by a solid body at a given temperature might be expressed in terms of wave length and temperature, and of the size and nature of the radiating surface.

A formula for this purpose was deduced, by means of which the temperature of the filament could be determined, provided a certain constant were known, which was determined for 33 different filaments belonging to two groups. Three of these filaments were black and the other 30 showed gray surfaces, and the mean value of the constant for the two groups was as 100 to 75, which is almost exactly the same relation which Leslie, at the beginning of the century, found for lampblack and graphite. It may therefore be asserted that incandescent lamp filaments with gray surfaces should be classed as graphitic carbon.

A very surprising result derived from the formula is that the normal temperature of the filament of all sorts of lamps is very nearly the same and is included in an interval between 1,565 and 1,580 degrees on the absolute centigrade scale. In the case of some lamps of very great brilliancy, that is to say, of lamps having thick filaments, which can be brought to higher temperatures without serious damage and which can consequently be operated at a higher economy, the normal temperature is about 40 degrees higher.

It is also necessary to know between what temperatures the filament changes when the candle power is varied through a considerable range from 2 to 30-cp for example in the case of a 16-cp lamp, or from 20 to 300-cp in the case of a 200-cp lamp; the result of measurements show that the temperature variations which correspond to such changes in brightness amount to about 180 degrees. In practice, accordingly, incandescent lamp illumination covers a range extending from 1,400 to 1,600 degrees C. for small lamps, and 1,450 to 1,650 degrees C. for large lamps. Applying these considerations to the formula, the simple law is deduced that every increase in the energy of a current amounting to one-half per cent. raises the stationary temperature of the incandescent lamp one degree centigrade.

The definitive quantity in the case of the incandescent lamp is the energy which the electric current develops in a filament in a unit of time; by means of this the temperature of a filament is determined when the surface is known, and thus finally the quantity of light which the filament radiates is given. One of the fundamental questions in the domain of incandescent lamp illumination is the relation between the amount of light radiated and the amount of energy necessary to its production. Prof. Weber found that the formula

$$\text{Candle Power} = KW^3 \quad \ldots \quad (1)$$

where W is the energy in watts and K a constant, is fairly well established. It appears, however, that the value of the co-efficient K is not quite a constant, but that it increases as the light increases from small intensities and then more rapidly with increasing brightness to a maximum, and finally diminishes again. For different lamps, however, the value of the co-efficient varies enormously—from 1.49×10^{-6} in the case of the 'Sunbeam" lamp to 70.4×10^{-6} in the case of an Allgemeine Electricitats Gesellschaft lamp.

From equations previously established Prof. Weber deduces the following formula, which applies to all lamps; the candle power refers to the mean spherical value expressed in British candles; K is the constant of the lamp, S the surface of the filament in in cm^2 and W the energy applied to the filament:

$$\text{Candle power} = \frac{6.8 \times 10^{-13}}{K S^2} W^3 \quad \ldots \quad (2)$$

From this formula Prof. Weber points out that the dimensions of a carbon filament to give a certain intensity of light under certain conditions can be calculated.

An important deduction made from the formulæ developed is that within a practical range a rise of n degrees in temperature will improve the economy of light production by nearly n per cent.

One of the important results of the investigation has a direct bearing upon the question recently raised as to the optical efficiency of the incandescent lamp. Prof. Weber finds that at normal temperatures of incandescent lamps their optical efficiency is in the neighborhood of one per cent. He refers to experimental determinations which give from four to five per cent. efficiency, but states that these were dependent upon an assumption that an aqueous solution of alum absorbs all the dark rays and lets through all the visible rays, which is not quite true, and a correction shows that these experimental results may be reduced to as low as three per cent. by applying corrections.

Prof. Weber states that it has long been known that the rapid diminution in the life of incandescent lamps with rising economy is to be explained by the fact that the carbon at a certain temperature begins to show notable vaporization, which with a further rise of temperature increases in intensity. A method is shown by means of which the point can be approximately determined at which the carbon begins to show evaporation, and where, therefore, this deterioration begins. This is variable with different lamps; with a Woodhouse lamp it was found to be about 1,610 degrees C. and with an Allgemeine lamp, 1,603 degrees C.

Electric Conduit Railways.

At the regular monthly meeting of the New York Electrical Society on November 1st, Mr. Joseph Sachs read an interesting paper entitled "Is There a Solution of the Electrical Conduit Railway Problem?"

Mr. Sachs gives as reasons why success has not been attained with electrical conduit railways thus far, that most of the projects were immature, the inherent difficulties are great and the cost of construction very large; on the other hand he thinks that the maintenance would seem to be less expensive than with the trolley.

After describing a large number of conduit systems, Mr. Sachs said that there was not much of a choice between them, as there had apparently been nothing practical evolved from the extremely large number described, except the plain open slot conduit and continuous wire system. This is the one that is in actual operation and has given satisfaction both at Budapest and at Blackpool, England, but he considered it doubtful whether it can be made practicable in this country, where the climatic and local conditions are different.

Mr. Sachs gives it as his opinion that we will never get a conduit system which can put in for $20,000 a mile, single track, and that it may be as high as $30,000 or $40,000 per mile, single track.

The system which is to be installed upon Lenox avenue by the Metropolitan Traction Company was then described; a section of the conduit is shown in the accompanying cut.

The ordinary conduit yoke will be employed and at the main holes, 30 feet apart, the insulators, which are of rectangular form and of soapstone, will be located, and supported in cups embedded in sulphur. At the top of the insulators is fastened an arm of iron. To this arm is fastened a contact conductor of channel iron. The contact shoe comes down to the slot and has two arms which press outwardly from the single supporting bar which rests on the rails, making a continuous rubbing contact. There being two conductors used there is no structural return.

As will be seen from the cut, the insulators are located in the manholes and are easily accessible. They are quite a distance apart and the voltage is low, it being intended to use about 250 or 300 volts. The conductors are very nearly directly under the slot, which was apparently the objection in some of the first systems, but the peculiar construction and location of the insulators in this system may prevent any trouble from this source.

An extended discussion followed the reading of the paper. Mr. C. B. Fairchild thought that it was a question whether there is any extraordinary demand for an underground electric system, and he quoted from an authority who stated that "a successful underground system would be a great calamity for the street railway interests of this country, from the fact that if one were adopted every little city throughout the country would demand that all the

wires be put unnderground, and it would ruin nine-tenths of the street railways of this country if they were compelled to operate under such a system." He described the underground system which is now being placed in Washington, D. C. The yoke is about the same as has been used in Washington on the cable construction, a little heavier, perhaps, and the conduit is about 25 inches deep and 18 inches wide; the conductor is a four-inch channel iron, four inches deep, and supported from the top instead of the bottom as will be the case in New York City, and headed with trunnion bands to provide for expansion. The cost is estimated to be more than the cost of cable construction, and Mr. Fairchild states that the Siemens Halske Company, who proposed at one time to put in an underground system, admitted to him that the cost would be more than the ordinary estimates for cable construction. In New York City, the cable roads were built for not less than $150,000 per mile single track, but in Washington the cost is about $30,000 per mile, of single track; ordinarily, however, the cost would be from $60,000 to $75,000 per mile with single track.

The difficulty of contraction and expansion in conduit conductors was referred to, and Mr. Fairchild stated that in Washington, where the temperature in the conduit varied from below freezing to 140 degrees, a great deal of difficulty had been experienced- in this connection. Mr. Fairchild fears that there will be difficulty in the Washington system through using a porcelain insulator, as he thinks it will require a material less hygroscopic, such as mica or something of that kind. He referred to the extreme dampness of conduits and thought that an economical street railway cannot run with a 300-volt current, at least 500 volts being required. A heavier construction will also be required to support electric cars than required for cable cars, on account of the motors, and the cost will be correspondingly great.

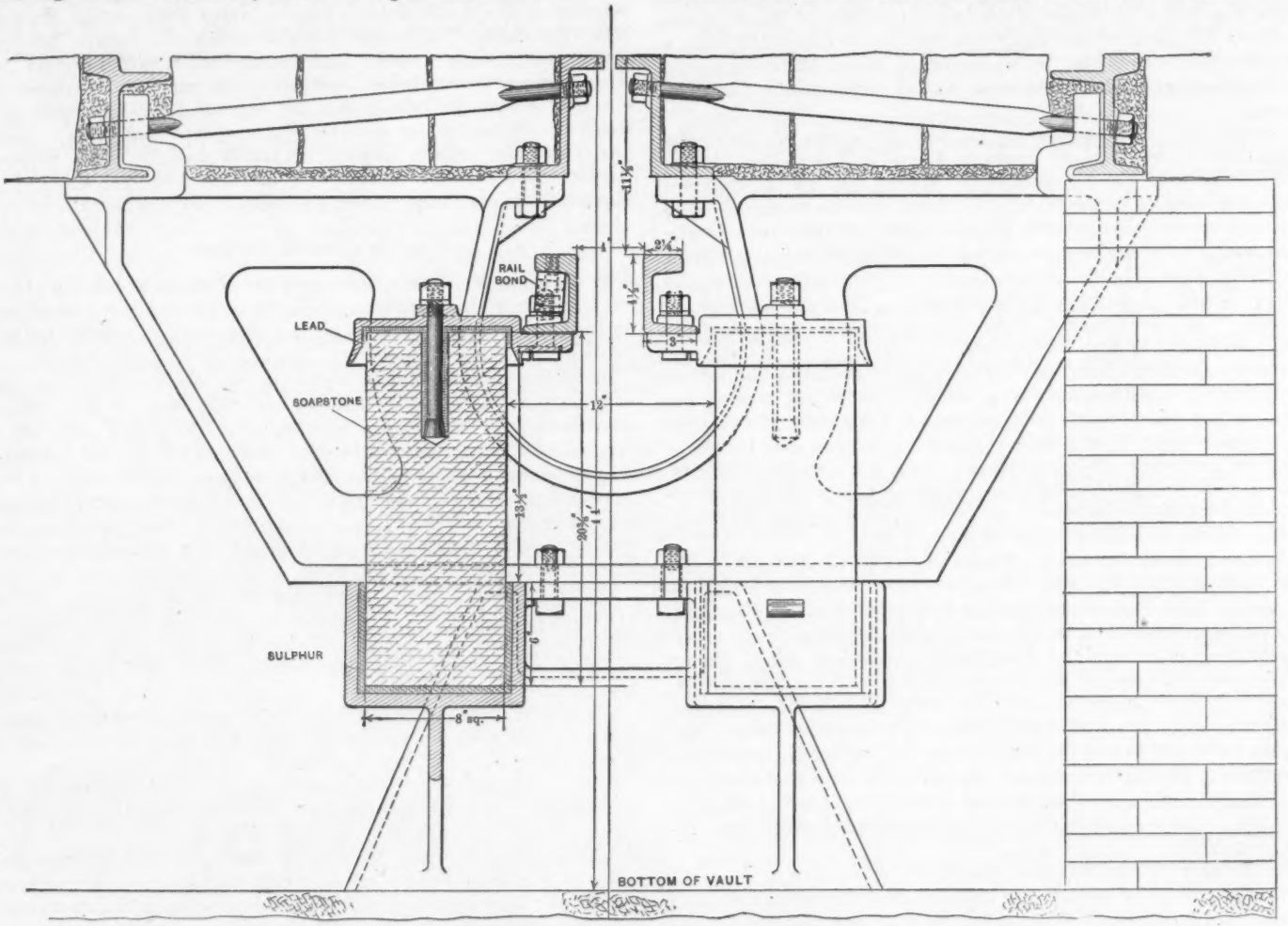
Electric traction is very much harder on the rails than cable traction where the headway is under three minutes. Even where the rail is from 75 to 80 pounds, the cost of maintaining the track where electric cars are used is surprisingly great. In answer to a question as to the comparative cost of the cable and electric roads, Mr. Fairchild stated that the cars in both cases would cost about the same but that the motor would cost from 10 to 12 times as much as the grips, or a difference of about $1,000 per car.

Mr. R. R. Lundell stated in regard to the Johnson-Lundell system which is now being tried at 59th street, that the storage battery used is a very small one but it carries the car through emergencies and will bring it back to the station in case of a breakdown. Through its use expensive electric conduit construction is done away with, also complications such as switches and cross-overs. Mr. Lundell gives as reasons for the adoption of this system that in New York City the open slot, owing to the size of the conduit, would necessarily be very expensive. The Johnson-Lundell system, he said, could consequently be installed much cheaper. The electro-magnetic device was adopted, as the electromagnet has shown itself to be positive. He stated that they are now ready to put down the system at $30,000 per car mile double track for the electrical equipment without rails or ties, and Mr. Sachs added that the track would cost about $20,000 a mile additional. The battery weighs only 1,500 pounds and takes care of itself; it is always sealed up and charged continously. The voltage is 300.

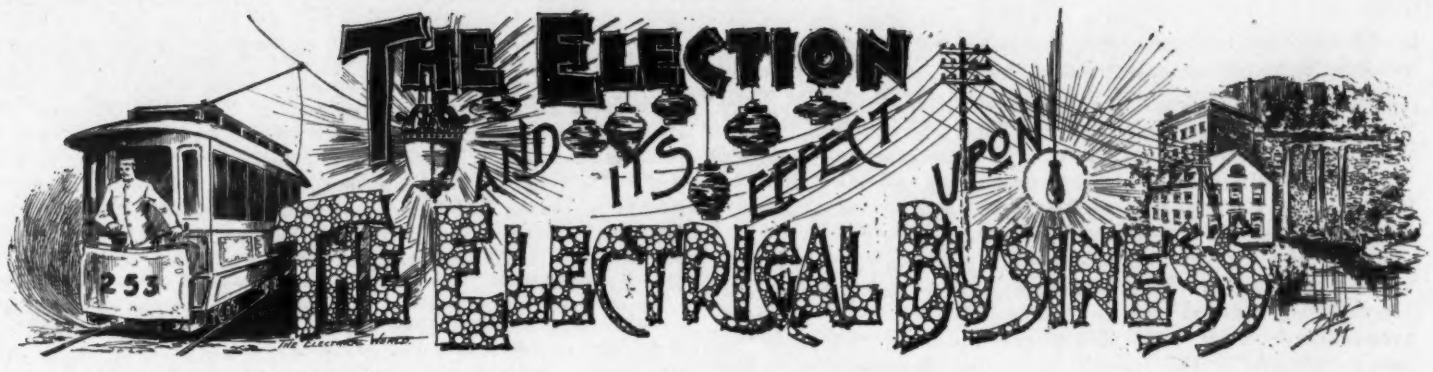
Mr. Field stated that in the case of one road which he put down, the cost of the trolley system was as high as $75,000 per mile for a single track, which included $20,000 per mile for paving the streets from curb to curb. He stated that the Budapest system, as modified in America, would fill all the requirements of American conditions. He said that the conduit which is going to be put in in New York City is a modification of the Siemens-Halske conduit.

Mr. E. A. Merrill described the three-wire system with which, he said, there was difficulty in balancing. At Bangor, Me., in going up steep hills, very frequently they would have to take the trolley off one side and put it on the other wire. The same difficulty in balancing was found in Milwaukee. He stated that he knew of one road where the cause of the difficulty was not discovered but the road was abandoned. He referred to the much greater investment in copper at 300 volts, which would be four times greater than at 600 volts, and said that it was not a very large road that puts in an investment of $100,000 to $150,000 in copper, so that at a reduced voltage it can be seen what the difference would amount to.

Mr. Fairchild questioned a statement to the effect that electric and cable roads in certain conditions were operated at about the same cost per car mile, as he had found that cable roads as a general thing, under the same conditions, are cheaper than electric roads.



Electric Conduit of Lenox Avenue Railway.



In order to furnish to its readers an indication of the sentiment prevailing among those connected with the electrical and allied business interests as to the probable effect of the recent elections, The Electrical World has made a canvass of the leading men connected with these particular branches of trade, and gives herewith their views on the subject. As those who speak are well qualified to judge of the situation, and as they voice the opinion of many localities, what they say will, we believe, be found of much interest. It will be noted that they are almost unanimously of the opinion, though no economic question was directly at issue, that the effect of the election will be exceedingly beneficial to the electrical industry as well as to others by settling for a term of years the recent disturbed business conditions.

Elbert Wheeler, treasurer Wheeler Reflector Company, Boston:—"We confidently expect immediate and gradually increasing response by the business world, because of the settlement of political matters. We firmly believe that as the atmosphere has so cleared itself, the outlook for the future is exceedingly bright."

A. A. Zeigler, president and general manager Zeigler Electric Company, Boston: "With the Republicans enjoying their large majority, and a considerable number of the people satisfied with a moderate tariff, everybody outside of a few grumblers appears to be content, and why should there not be encouragement for new enterprises?"

Norman Marshall, president Iona Manufacturing Company and vice-president Anchor Electric Company, Boston: "Manufacturers generally will now know just what they can depend on for five or ten years to come, and dealers will not hesitate to stock up, so that the present gratifying activity in our particular lines of business we look to see continued for a considerable time to come."

D. A. Andrews, Jr., vice-president and treasurer of the Pettingell-Andrews Company, Boston: "Apart from any political views I may have, my opinion of the election is that we shall have an increased volume of trade and better feeling. My reason for this is that everything points to Republican rule for some years in both local and national politics, and this will give a more settled feeling than could be if the vote had been closer or less pronounced. Settled politics is what we want and not change, whichever party is in power."

Frederick Fosdick, president Fitchburg Steam Engine Company, Fitchburg, Mass.: "The forecast in the opinion of mine published in the Electrical World of September 1st has been fully realized. 'Mongrel Tariff bill passed;' reduction in wages and strikes everywhere, and consequently a 'reduction in purchasing capacity.' The tremendous overturn by the recent election shows conclusively that the people intend to stop 'blood-letting' from the national heart by tariff tinkering, and in my opinion confidence in the future will be at once restored. To be sure, purchasing capacity is less, but general stocks of merchandise are very low and a moderately increased demand, which there is sure to be, will give a healthy tone to business, and I look for a large increase by spring. The country has been going hungry for nearly two years, and with return of confidence will take steps to partially, at least, satisfy its hunger. I can see no chance for immediate increase of wages under the competition the present tariff bill has brought. The electrical industry has suffered less than most, I believe, but with return of active manufacturing and confidence of investors this business must receive a large increase. The strength of the expression of the popular will is such that I look for five to eight years of great prosperity, on a sound basis."

W. E. Sessions, manager Sessions Foundry Company, Bristol, Conn: "I believe that the effect of the elections on business in general will be very beneficial indeed; and although I do not look for a boom right away, still I anticipate a decided improvement and general resumption in all lines of business."

R. F. Blodgett, secretary of the Pratt & Whitney Company, Hartford, Conn.: "The elections give overwhelming evidence of the dissatisfaction of the people of the United States with the recent tariff legislation and their decision to bring about a change as quickly as possible to a condition of protection to farmer, laborer and manufacturer. The desire for sound money and honest administration of municipal affairs was also strongly emphasized, and the result will be a restoration of confidence, revival of business in all lines except those that have been temporarily 'knocked out' and the starting of new enterprises."

Z. Chaffee, president, Builders Iron Foundry, Providence, R. I. "The effect will be beneficial. Several of the municipal and state elections are victories for those desiring honest government, which does much to create confidence in the business world. Probably the majority of business men are also pleased that the Republican party will return to power in Congress, but any immediate efforts to again unsettle the tariff would be prejudicial."

H. N. Fenner, treasurer, New England Butt Company, Providence, R. I.: "I should depreciate any undue impulse to the business of the country as a result of the recent Republican tidal wave. We do not want a boom but a slow and healthy growth that will be lasting. If the result is a guarantee of no tariff agitation and sound currancy legislation, then there is a basis of confidence, and confidence is all that is required to bring back our former prosperity. Renewal of commercial prosperity means the renewal of activity in the electrical industry, for it is as much a part of the commecrial industry of the world as any business interest."

T. J. Smith, Esq., manager of The E. S. Greeley & Company, New York: "The patient will immediately begin to acquire strength and an uninterrupted progress toward complete recovery may be confidently expected."

Charles P. Geddes, secretary and treasurer of the Interior Conduit and Insulation Company, New York: "Our company is doing better to-day than it ever did, and everything looks favorable for a prosperous winter in the electrical industries.'

James L. Robertson, president Hine & Robertson Company, New York: "I consider the results simply GRAND, and that they will do more to restore business to its normal condition—at an early day—than could have been done through any other means."

W. P. Jones, secretary Law Battery Company, New York: "Personally speaking, we experienced a revival of business before election; therefore, if the outcome of the balloting is to be beneficial it will be with us a case of large favors thankfully received."

W. H. Leitch, of Abendroth & Root Manufacturing Company, New York: "It is rather early to prognosticate, but the result must prove beneficial. Electric light plants and trolley road power houses have given us plenty of boiler work for several months, and there is now a pronouncedly better feeling."

George L. Colgate, New York: "On general principles politics has nothing to do with business. The recent election assures a restoration of confidence. Supply and demand will do the rest. We are entering an era of prosperity which has the prospect of permanency, such prosperity as this country is capable of and Americans are able to appreciate."

J. H. Vail, president Electrical and Mechanical Engineering and Trading Company, New York: "I consider the result of the elections of November 6th as largely tending toward a settlement of the disturbed business conditions of the country that have ex-

isted for the past two years, and I fully expect to see the electrical and kindred industries make marked advances at an early date."

Walter C. Kerr, of Westinghouse, Church, Kerr & Company, New York: "Our business this fall has been characterized by fickleness. We have had our hopes raised at one time by orders and inquiries, when shortly afterwards the bottom would seem to drop out of trade. Now that the election is over, however, I look for steadier times, but do not think we will have more than a moderate winter trade."

F. A. M. Burrell, of Charles A. Schieren & Co., New York: "We have had a good fall business, and I am confident dull days have left us. Though the productive powers of this country have rather exceeded the consumption for some time, I think the natural growth of the United States and extension of foreign trade will before long eliminate over production for many years."

H. C. Adams, president of the Phillips Insulated Wire Company, New York: "The results of the election must restore confidence all around, and business should soon be mending for the better. Tariff changes make no difference to us; business has been as fair before the recent changes as after, but the knowledge of a certain basis to work upon makes the conduct of future business more certain and more fruitful of results."

H. J. Gorke, manager Electric Engineering & Supply Company, Syracuse, N. Y.: "Regardless of all party feeling or political preferences I look with a great deal of encouragement for positive and favorable results in all lines of business, as the effect of the recent election will have a strong tendency toward establishing stability and confidence in both the manufacturer and buyer. At present our business is far ahead of our anticipations."

C. B. Miller, of the Magnolia Metal Company, New York: "In restoring a feeling of confidence that has been lacking, the outcome of the elections will prove a source of much gratification. The assured end to tinkering with the currency and the tariff lifts a load off the minds of the business men of the land. They are now in a position to gauge ordinary conditions and will again begin to assume the legitimate risks that belong to true business development."

An executive officer of the General Electric Company, New York, who did not wish to be quoted personally: "I think the settlement of the political strife will have a satisfactory effect upon all industries. There is no probability of an immediate boom, for it will take us some time to reach the pinnacle we came down from. However, the General Electric Company is doing well and all of the electrical industries are bound to be benefited by settled trade conditions."

George J. Jackson, general manager Norwich Insulated Wire Company, New York: "The requirements of feed wire for trolley roads is such as to make big demands for underground insulated wire. We have two extensive orders at Boston and Chicago to fill, and to complete all of our contracts on time we have had to run our factory day and night. Naturally we are satisfied with things, and as to the election I cannot see but that every industry will be benefited by the result."

Capt. Willard L. Candee, manager of the Okonite Company, New York: "Everything, comparatively speaking, has been dead for two years, but as people have now used up all of their tide-over supplies I believe prosperity is upon us. I do not look upon the settlement of the political issues as a harbinger of good times any more than in the attention given to politics instead of to business for the time being. We have orders enough to keep us busy, and look for a continued active fall and lively spring trade."

The Partrick & Carter Company, Philadelphia: "The results of the late elections can have only a beneficial effect upon the business interests of the country. The people (irrespective of party affiliation) were tired of tariff tinkering and threats of further changes, and they voted for a Republican majority in the lower House of Congress, which insures a rest from tariff agitation. Business everywhere ought to experience a revival from now on, and 1895 should bring a return of prosperity to all commercial, manufacturing and financial interests."

A. Mitchell Hall, general manager of the C. & C. Electric Company, New York: "The business world of America, including both employers and employed, has expressed most decisively its wish that further legislative agitation shall be stopped, and that business be allowed to resume its normal condition. I feel that the electrical business in particular has a very bright outlook, and that the revival of confidence will shortly be felt in the large increase of electric transmission as a means of economizing in cost of manufacture in isolated plants, and in transmitting power long distances."

Thomas C. Wood, president the Ball & Wood Company, New York: "Whatever affects the commercial must affect the electrical interests of the country, and the result of Tuesday's election will re-assure business men of both political parties, since it seems to promise conservative legislation in Washington for some time to come. To New York business men who want public affairs administered on a clean and honest basis, the situation is full of encouragement and hope, for the moral influence of the election will be felt not only in the City Hall, but in every counting room and workshop in the city."

Ralph L. Shainwald, president of the Standard Paint Company, New York: "Anything that tends to make the operations of general business more stable is certainly an advantage. That the result of last weeks elections has this tendency is unquestionable. The electrical industries being among the most active of our present system, will, it seems to me, be among the very first to benefit by a better regulated order of things. We found that these industries especially began to grow active immediately after the panic, and with the even better outlook that is now discernible I believe they will be very active from this time forward."

R. E. Gallagher, secretary of the New York Insulated Wire Company, New York: "We do not anticipate any change, except for the better. The demand for our wire this fall has been sufficient to keep us busy, and now with politics aside people will give more attention to business. There is no danger of more tariff tinkering for several years, which is something to be thankful for. We can not expect general trade revival so long as there is such an enormous amount of money tied up in the banks. This is the keynote to the situation and when that begins to move we may all feel assured that prosperous times have come to stay.

Frank M. Pierce, president of the Pierce & Miller Engineering Company, New York: "I cannot see why the effect of the recent elections on the industrial interests of the country should not be wholly good, as it settles the question of tariff tinkering until the end of Mr. Cleveland's administration at least, for neither party will have sufficiently strong control in the national legislation to carry out their opposite ideas regarding the tariff. This enables business men to look ahead and plan with certainty, thus restoring confidence, and letting loose the capital which is now lying idle owing to lack of confidence. The electrical industries offering a good, safe and profitable investment for capital, will undoubtedly be greatly benefited."

Charles D. Shain, New York, Eastern representative of the Siemens & Halske Company: "I can see no reason to change my former views expressed at the time of the tariff changes. I do not anticipate that the tariff will be again raised and believe that the conditions existing in this country to-day are so different from those existing years ago that a high tariff is neither necessary nor beneficial to the electrical interests. Unquestionably there was a time when tariff protection assisted largely in making this country the great one that it is, but in my opinion this has passed by and with free trade or something near to it the manufacturers of electrical apparatus in this country can compete in the markets of the world."

E. K. Conover, of the Conover Manufacturing Company, New York: "It is a matter of course that the electrical industry will be benefited by the outcome of the 1894 landslide. There has been enough business in sight all along, but it is not exaggerating a bit to estimate that nine-tenths of the orders in sight have been held up awaiting what the future, as affected by the economic policy of the victorious party, had to offer. These held up orders will now be released, and there should be an immediate rejuvenation of business. This applies not only to the electrical trade, but as the further introduction of electricity depends upon the progress of commerce in general, it and its allied trades will be in the front rank in any spread of activity."

Charles McLaughlin, of J. H. Bunnell & Co., New York: "The nullification of any tariff meddling by Congress by reason of the contrary political opinions of the President, will give to the business interests a sense of security sadly lacking of late. Congress with a Republican majority will certainly not pass any measure that Mr. Cleveland can approve, and it is equally as certain that it will not act in accordance with any suggestions that he may set forth in his annual message. Mr. Cleveland can also be depended upon to lend his approval only to sound financial measures, and this assurance is a great comfort to the business men of the country, who in recent years have had to contend with any number of un-

toward circumstances as a result of ill advised legislation. With us trade has been very good all along and promises to be even better."

James H. Seymour, president Clark Electric Company, New York: "Your method of obtaining the views of those connected with the electrical and kindred industries in relation to the business outlook for the future is wise. The causes of the severe business depression are both political and commercial, but these have now been mostly corrected; therefore, the future is promising. Never in the history of electricity has the industry been conducted on so sound a business basis as it is now. Business depression, while a severe experience, is valuable. The vote to authorize New York City to loan its credit to the extent of fifty millions for rapid transit is important, as electricity will be called upon to furnish the motive power, light and heat. No industry has so bright a future as electricity, and the press representing that industry has a wide field of usefulness."

Gen. E. S. Greeley of The E. S. Greeley & Company, New York: "It is too soon to be actually benefited by the election, but we are now more hopeful. I think any business man of whatever political opinions must feel better satisfied with the conclusion of political issues. One blessing is that there can be no detrimental legislation on silver or tariff. One of the surest ways to make hard times is to begin tinkering with these questions. The natural outcome of it is the hoarding of money and the paralyzing of industries. One of the hurtful things to the electrical industries was the abrogation of all reciprocity treaties. Since the new customs law has taken effect some of the South American countries have put heavy duties on American electrical apparatus and in some cases the duties have been made almost prohibitory, notably by Cuba. I trust that this will be changed. We now anticipate doing more business in our home markets."

Mr. A. L. Doremus, assistant to President S. S. Wheeler, of the Crocker-Wheeler Company, New York: "Of late we have been receiving a good many inquiries relative to factory installations. Any number of large companies throughout the manufacturing sections of the country are preparing to supersede their old steam plants with electric power, but they have held up their orders pending the election. I recently travelled through Connecticut, and while the many inquiries for estimates seemed to indicate that the Republican victory, with its assurance of unchanged tariff conditions, had been in some measure discounted, there were cases in which definite contracts were held off until there should be a certainty that business calculations would not further be upset by congressional interference. Trade in dynamos and motors has been only fair with us recently, but the clinching of many conditional contracts will greatly help to increase its volume."

J. J. Gorman, of the Manhattan Electrical Supply Company, New York: "I feel 50 per cent. more encouraged than even last September when the certainty that tariff agitation had ended—for the time being, any way—led one to hope that some trade revival was at hand. The dread, however, of the impending elections prevented much permanent improvement. For quite a period we have not taken in any long-time contracts. Engineering and supply houses have been unwilling to assume much risk. We have, moreover, supplied jobbers with little more than what their orders from their retailers called for—their orders to us being almost exact fac-similes of what their customers wanted for immediate use. This is now changed. We are already apprised of orders from jobbers for stock purposes. There are evidences of business ahead, and jobbers and supply houses are beginning to prepare for it. The revival in trade will not assume large proportions all of a sudden; it will, however, be steady and continued and that's the kind that counts."

James P. McQuade, secretary and treasurer of the National Conduit Manufacturing Company, New York: "I can give you the honest opinion of one of our directors, who has been a life-long Democrat, and is to-day a leader in one of the Assembly districts of Tammany Hall, which is as follows: 'If the political landslide had occurred in New York City only, I would have thought it was a crusade against Tammany Hall, but it is the same thing all over the United States, even away down in Texas; it was my opinion the working people of the United States thought they wanted low tariff, but they have changed their minds and are unquestionably of the opinion that a protective tariff is the best thing for this country.' I, myself, look for a great boom in the electrical business following this election, as in our own immediate line there was one large contract that entirely depended upon the success of the Republican party, as the promoters of the enterprise did not feel like putting their money into a new scheme unless they were assured of a better feeling in the financial world, which would enable them to dispose of their securities They felt that Wall street would be more in humor to take electrical securities if the Republicans were in power than it has been for the last two years."

S. F. Bagg, secretary Watertown Steam Engine Company, Watertown, N. Y.: "In so far as business has been held back and waiting until the election was over, we shall of course now see decidedly more activity. This I think is always the case with every election, regardless of the result. Aside from this, however, I do not believe the result of the election will affect business for good or evil. Of course a large majority of the business world undoubtedly feel more confident of a speedy revival, and this very confidence will in itself beget business. On the other hand, while the very sweeping Republican success will effectually prevent Democratic interference with the tariff for the next two years—it also suggests the strong possibility of another general revision at the end of that time should the Republicans elect a president and control Congress. Perhaps one consideration will offset the other. We are inclined to think that the force of the panic or depression has spent itself and that a gradual but sure resumption of business must come independently of the result of the election."

Carlton M. Williams, secretary and treasurer Morse, Williams & Co., Philadelphia: "Some one has remarked that the hardest things we have to bear in life are those that never happen. I think that while this country has such great resources that it can adjust itself in time to most all conditions. The constant tinkering with the tariff keeps business men in such a state of unrest that they have not confidence enough to make contracts excepting for immediate execution, and thus business is greatly retarded in all directions and kept in a very unsatisfactory state. The large Republican majority in the 54th Congress will prevent any further tampering with the tariff, and it being well known, and a generally admitted fact by even the Democrats of this section of the country, that the Republican party stands for sound financial legislation. I think if some arrangement could be effected by international agreement whereby the use of silver on a safe basis could be more generally established, we could look forward in this country to a season of great prosperity for a number of years to come. Of course we cannot expect to jump at once into that condition, but the growth of improvement would no doubt be appreciable in the near future and then we should go steadily forward in the right direction."

S. M. Hamill, general manager Brush Electric Company, Cleveland: "I believe that the fact of the Republicans being in control of the House and possibly the Senate, will have a most beneficial effect on the electrical business, as well as all business, for the reason that business men will be assured that there will be no further changes in the tariff for some time to come and certainly this in business is a great advantage. The electrical interests are so interwoven with other commercial interests that whatever benefits the latter will benefit the former. Recovery will, however, be gradual. It will take some time before we reach a period equal to the 'good old days' of 1891 and 1892; but I believe that the recent hard times have taught us all lessons which, if well learned and followed, will place our electrical business on firmer foundations and make advancement greater than ever before."

Chas. F. Thompson, manager of the Lane & Bodley Company, Cincinnati: "The future historian will ascribe the condition prevailing in the latter part of this century to the extraordinary development of metallurgy. It will be the Bessemer era, the triumph of engineering science in the mine, furnace and factory, the steady reduction of costs, the fierce struggle of manufacturers in competition. This will explain cheap silver, copper, iron and steel. He will chronicle the futile endeavors of politicians to maintain values by forced coinage, schemes of tariff and class legislation and the final acceptance of their failure by the people. He will recognize a repetition of the past, when similar great strides of progress were as reluctantly accepted, and will record that the American people accepted the lesson in 1894, started afresh, as it were, forgetting the past for the time, yet deeply impressed with what they had experienced. The electrical field will prosper; its newer branch, the transmission and conversion of power, will receive attention by every machine manufacturer. Lighting and transportation will gradually extend until every village has light and every county seat a street railway—not so rapidly as we would desire, perhaps, but a steady growth in volume and profits month by month."

J. E. Keelyn, president Western Telephone Construction Company, Chicago: "With liquidation largely accomplished and uncertainty now dispelled, the mother of invention will come forth

to greet progress. As the first pickings of industrial genius are found in the electrical field, a good cupful is reasonably assured."

J. B. Wallace, manager Wallace Electric Company, Chicago: "The election was so uniform and the majorities so unprecendentedly large that the moral effect is very much the same as if it had been unanimous. In consequence of this the effect in restoring confidence and upon business will be considerable and immediate. Not only will general business be helped, but particularly the electrical interests. Being so new an industry it requires capital faster than it can at first be made out of the business, and general confidence is an important fact in obtaining such capital."

Geo. F. Stitch, vice president of the Western Telephone Construction Company, Chicago: "I opine, not as a partisan but as a business man, that the industrial condition of our country will now begin to improve. The overwhelming majority that was given for protection against free trade will certainly restore business confidence, and the moneys that are now locked in the safety deposit vaults and banks of the country will find their way into the different trades. Thus the circulating medium will be put to its proper use and from now on, I believe there will be a permanent improvement, not only in the electrical business, but in every business throughout the United States."

Thos. I. Stacy, secretary and treasurer Electric Appliance Company, Chicago: "It occurs to me that the very decisive nature of the recent Republican victory settles without doubt the result of the next Presidential election, and, therefore, determines the general political policy of the country for the next five or six years. Leaving out of the question entirely, therefore, the merits of high or low tariff, the simple fact of six years probable stability is, in itself, amply sufficient to fully overcome the already rapidly disappearing financial depression. We seem justified, therefore, in the assumption that business interests will experience a rapid revival, and when that revival is complete, we may, I think, expect the few years of exceptional prosperity for which we have been patiently waiting."

Lag Angle of Alternating Currents.

The question recently discussed in these columns as to what shall constitute the angle of lag in alternating circuits where the current is not harmonic was referred to in the discussion of Mr. Steinmetz's paper at Philadelphia by Dr. Bedell, whose remarks were as follows:

"There is one point to which a little further attention might be given, and that is in regard to the lag of the current behind the electromotive force when the current and electromotive force are not harmonic. Those who have had occasion to make a study of currents which are not strictly harmonic, and desire to find the phase relations, have doubtless met this question. The phase difference between the maximum values and zero values or any other values of the current and electromotive force, are not the same. The use of the equivalent sine function is the solution of this question. We assume an equivalent electromotive force which is harmonic and has the same mean square value as the electromotive force which is not harmonic, and we do the same with the current. We then set these two with such an angle of lag between them that the power is the same. Now we can get our power from other measurements and by these measurements of the power, the current and the electromotive force, we thus have a measure of the angle of lag in degrees which cannot be otherwise obtained when the currents are far from being harmonic. In other words, we say the power is $W = E\,I \cos\theta$. By measuring W, E and I, we may find a value for the angle θ, whether the current is harmonic or not.

Good Use of Poor Coal.

A poor quality of coal which is found in a certain mine in Germany, and which is too poor to be transported to any distance, is made use of by the erection of a large electro chemical factory next to the mines in which chlorine and soda are manufactured by an electrical process.

Nitric Acid from Air.

Dr. Froelich announces that a process has been discovered which admits of commercial application, for obtaining nitric acid from the nitrogen in the air by an electric process based on the action of ozone; the process is as yet a secret but a description of it will soon be published.

Notes on Recording Meters.

BY EUSTACE OXLEY.

Nothing is of more importance to electric light companies doing business on a meter basis, than to have their meters record correctly; and to insure their doing so, it is necessary that care be taken to observe certain conditions, as to where and how they should be installed. More esperially is this the case with motor meters; and as my experience has been largely with meters of that kind, and particularly with the Thomsom recording watt meter, I will refer only to that type.

To install the meter in a suitable location, is of the first import ance. It should be located in a clean, easily accessible place, free from moisture, vibration and liability to mechanicaal injury. If these conditions are not complied with, trouble is likely to develop sooner or later, and prevent the meter recording correctly—causing it in almost every case to run slow, and therefore in favor of the customer, hence, to the company's loss.

The meter should be inspected within a day or two after having been installed, to make sure that it is running properly, and that all connections are tight, etc. It is advisable to have the meter placed where it can be readily got at, so as to facilitate reading and inspection; although it would seem to be the aim of some companies, to put them in the most inaccessible places, as for instance, under shop counters, near the ceiling in the show windows of stores, etc. Should the meter be located in a damp place, the commutator quickly becomes tarnished, rust attacking parts of the recording gear and accumulating on the permanent magnets, sometimes to such an extent as to choke up the space between the magnet poles and the revolving disc, thereby stopping the meter. I have frequently seen this occur, and as the effect is gradual, it is not likely to be noticed (unless regular inspections be made) until after many weeks, in some cases months, during which time the company would be steadily losing income on that meter.

When dust or dirt get into the meter, as it will in some places unless extra precautions be taken, it is liable to cause friction in the recording mechanism, and by collecting on the armature and copper disc, put a load on the meter, causing it to run slow. Care should therefore be taken to fill all spaces round the wires where they enter the meter. This precaution is very necessary when the meter is situated in places where such insects as cockroaches abound. I have seen a fully loaded meter (installed in a butcher shop) stopped by cockroaches collecting on the disc and armature. This meter was removed and another substituted, which was pro, vided with rubber diaphragms, over the holes where the wires entered, and extra care was taken to fill all crevices, where it was thought the insects could enter; in spite of which, however, it was found after a month's time to have stopped from the same cause.

Vibration is liable to fracture the jewel and weaken the permanent magnets; meters should not therefore be placed near elevator shafts, nor in places where they are liable to be effected from this cause. Rough handling either before or when the meter is installed, is frequently the cause of its not recording correctly, hence the advisability of frequent inspections. There is probably no meter on the market more perfect in its construction, or more reliable in its working, than this type which, when installed with ordinary care, I have always found an instrument whose constancy and sensitiveness, remain unchanged.

An Electrical Parrot Teacher.

According to London *Electricity* a Mr. Hill of Manchester, who seems to have invented a number of curious and useless contrivances, has lately devised an electrical parrot teacher, which is made up of a phonograph, a motor, an electromagnet, a battery, a mirror, an electric bell, a piece of sugar, a cage and a parrot. One advantage is that the parrot can be taught anything, even Chinese or Russian.

Areas of Circles.

Our contemporary, the London Electrician, gives the following simple rule of Mr. Gray. Instead of multipliyng the square of the diameter by 0.7854, his rule is to multiply by .7, repeat the result, double it and repeat the latter again, writing each successive product one decimal place to the right and add up the figures; the result can readily be shown to be the exact equivalent of multiplying by the above constant.

Electrical Power Transmission—II.

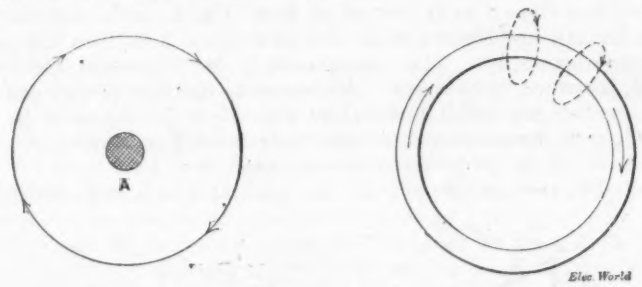
BY LOUIS BELL, Ph. D.

Concerning Electrical Energy.

10. In electric currents we have a very different state of things. The energy supplied by the electromotive stress instead of becoming potential as electrostatic strains, does work and is transformed into other kinds of energy, thermal or chemical, mechanical or luminous.

When a stress of whatever kind is applied to a body, only a limited amount of energy can be supplied by it so long as the energy remains potential. Thus in our box of jelly before referred to, a twist of given intensity applied to the stick, as for instance by a string wound around it and pulled by a given weight, can only transfer energy until the stresses produced in the jelly come to an equilibrium with it. On the other hand if the box were filled with water and the stick were the axle of a sort of paddle wheel, the very same twist could go on communicating energy to the water as long as one chose to apply it.

This roughly expresses the difference between electric charge and electric current, viewed from the standpoint of energy. An electromotive stress applied to a wire *charges* it and then the transfer of energy ceases. If the same stress be applied under conditions that allow work to be done by it, energy will be transferred so long as the stress is kept up. In an open electric circuit we have a charge as the result of electromotive stress. When the circuit is closed, *i.e.* when a continuous medium is furnished on which work can be done, we have an electric current. The amount of this work and the flow of electrical energy that produces it, depend on the nature of the circuit. Certain substances, especially the metals, and of metals notably copper and silver, permit a ready transfer of energy in and about them. Such substances are called good conductors. The real transfer of energy doubtless takes place *via* the ether, but its amount is limited by the amount and character of the matter on which work can be done.



FIGS. 1 AND 2.

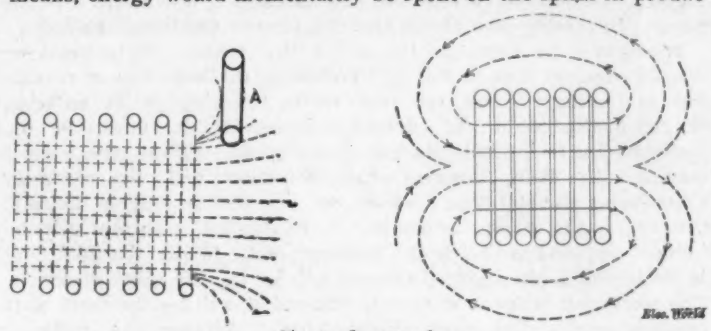
11. Whenever the strains in the ether, such as we recognize in connection with electrical charge, shift through space as when a current is flowing, other strains bearing a certain relation to the direction of flow are made manifest. Where there is a rapid and intense flow of energy these strains are very great and important compared with any electrostatic strains that exist *outside the conducting circuit.* In other cases they may be quite insignificant. These strains are electromagnetic and with them we have to do almost exclusively in practical electrical engineering. They exist wherever there is a moving electrical strain, whether produced by moving a charged body or causing the charge upon a body to move.

Both kinds of strains exist in radiant energy, as in other cases of flowing energy. The stresses in electromagnetic energy are at right angles both to the electrostatic stresses and to the direction of their motion or flow. If for example we have a flow of electrical energy in a straight wire (Fig. 1), the electromagnetic stresses are in circles about it.

If A be a wire in which the flow of energy is straight down into the paper the electro magnetic stresses are in circles in the direction shown by the arrow heads. If the wire be bent into a ring (Fig. 2) with the current flowing in the direction of the arrows, then the electromagnetic stresses will be (following Fig. 1) in such direction as to pass downward through the paper inside the ring

12. These electromagnetic stresses constitute what we call a *magnetic field* about the wire. The intensity of this field can be increased by increasing the flow of energy in the desired region in the systematic way suggested by Fig. 2. If, for example, we join a number of rings like Fig. 2 into a spiral coil shown in section in Fig. 3, in which the current flows downward into the paper in the lower edge of the spiral, there will be produced a magnetic field in which the stresses have the directions shown by the arrows. Such a spiral constitutes a genuine magnet, and if suspended so as to be free to move would take up a north and south position with its right hand end toward the north. In and about the spiral there exists a magnetic "field of force," which is merely another way of saying that the ether there is under stress. Its condition of strain is somewhat analogous to that about an electrofied body, and, as in that case, there is no work done on the ether after the strains are once established. While this is being accomplished work *is* done just as when a body is charged.

13. If now setting up such an electromagnetic field requires energy to be spent by causing a current to flow in the spiral, we should naturally expect that if the same field could be set up by extraneous means, energy would momentarily be spent on the spiral in producing stresses and strains similar to those that set up the original field. This is found to be so, the process working backward as well as forward.



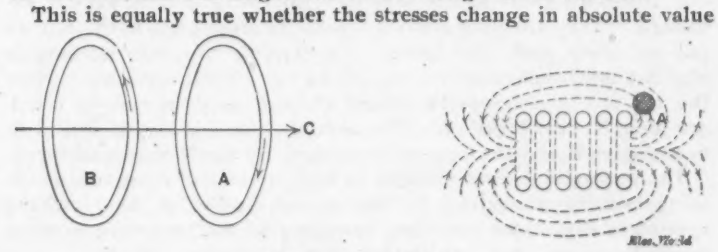
FIGS. 3 AND 6.

If, for example, we have two rings (Fig. 4), and by sending a current around one, transfer energy to the medium outside it, this energy will set up an electromotive stress in the other ring. The direction of this stress is not at once obvious, but we can get a pretty clear idea of it by considering the work done. If current is started in A (Fig. 4), in the direction shown, electromagnetic stresses are produced in the direction of the arrow C. If these are to do work on B, the electromotive stress in the latter cannot have such a direction as to set up on its own account a magnetic field that would *assist* that of A, otherwise we could increase the field indefinitely without added expenditure of energy. Therefore the electromotive stress in B, and hence the current, must be in a direction opposing the original current in A, as shown in the figure.

In like manner if the current in A be stopped and the field due to it therefore changes, there is a change in the electromagnetic stresses about B that again sets up an electromotive stress in it. If, however, this change of stress is to do work the electromotive stress in B must be of such direction as to oppose by its field the change in the field of A—*i. e.*, it must change its direction and will now give us a current in the same direction as the original one in A. All this follows the general law, that if work is to be done by any stress it must be against some other stress. There can be no work without resistance.

In Fig. 4 we have the fundamental facts of current induction on which depend most of our modern methods of generating and working with electrical energy. Summed up they amount to saying that whenever there is a change in the electromagnetic stresses about a conductor, work is done on it, depending in direction and magnitude on the direction and magnitude of the change in the stresses.

This is equally true whether the stresses change in absolute value



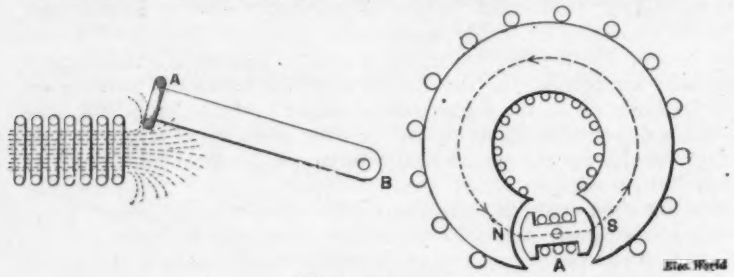
FIGS. 4 AND 5.

or whether the conductor changes its relation to them. Thus in Fig. 4, if A carries an electrical current the result on B is the same whether the field of A changes through cessation of the current or whether the same change in the stresses about B is produced by suddenly pulling B away from A. The rate at which work is done depends on the rate at which the stresses are caused to change, as might be expected. While the stresses are constant with reference to the conductor in which current is to be induced, no work can be done upon it.

14. These principles form the foundation of the dynamo, motor, alternating current transformer and many other sorts of electrical apparatus. Their details may differ very widely, but we can get all

the fundamental ideas from a consideration of Figs. 3 and 4. To somewhat define the specific idea of the dynamo, consider what happens when a conducting wire is thrust into a magnetic field such as is produced by a coil, as in Fig. 5. As in Fig. 3, let the current in the coil be flowing downward into the paper in the lower half of the figure. A is the wire perpendicular to the plane of the paper in front of the coil, its ends being united at any distant point that is convenient. Knowing that moving the wire into the field will set up electromotive stresses in it, we can as before determine their direction by remembering that work must be done. That is (see Fig. 1), the induced current will flow through A downward into the paper. In passing out of the field the current would be upwards.

We have so far neglected the rest of the circuit. To be exact we should consider it as in Fig. 6. Following the same line of reasoning as in Fig. 5, we see that while the ring A is entering the magnetic field the current induced in it must be opposite to that in the inducing coil (see Fig. 4). When the coil is leaving the field, however, this direction will be reversed. Considering the coil A as a whole, we see that so long as the total field tending to set up stresses in it is *increasing*, a current will be induced opposed to that in the inducing coil. While the total field is diminishing, the induced current will be in the other direction. The work that is spent in moving the coil A will for the most part reappear as electrical energy in that coil. Arrange the parts of Fig. 6, so that the motion of A can be accomplished uniformly and continuously and we should have a true, though rudimentary dynamo. Such a structure could be made by fixing A to the end of an arm pivoted at the other end and then revolving the arm so that at each revolution the coil A would sweep through the field of the magnetizing coil (see Fig. 7). The result of this, as we have seen, would be on entering the field a current in one direction, and



Figs. 7 and 8.

on leaving, a current in the other. There would thus be an alternating current developed in the ring A. If it were cut at some point and wires led down the arm and to two metal rings on the axis B we could obtain, by pressing brushes on these rings, an alternating current in any outside circuit. To make more of the revolution of the arm useful we could arrange coils in a circle about B. There would then be an alternation as A passed each coil.

All these devices, however, would produce comparatively weak effects because it is difficult to produce powerful magnetic stresses in so simple a way. There are very few materials in which magnetic stresses are easily set up or propagated. Chief among these is iron, which bears the same relation to magnetic effects that copper does to electrical ones. By giving to the coil in Fig. 7 a core of soft iron the electromagnetic effects obtained from it would be greatly enhanced. They are comparatively feeble in air and the more iron we put in their path the better. Developing this idea we have in Fig. 8 a much better device for setting up electric currents. Here the coil of Fig. 7 is wound around an iron core the ends of which are brought near together. The arm of Fig. 7 is also of iron with enlarged ends and the ring A is replaced by a coil of several turns.

The magnetic stresses brought to bear on the coil A are thus made comparatively powerful. Following out on Fig. 8 the reasoning applied to Fig. 7, we see that considerable electromotive stresses would be set up by the revolution of A, alternating in direction at each half revolution. In fact A is the armature of a simple alternating dynamo, having two poles N and S, so-called from their magnetic relations (see Fig. 3).

We have not thus far considered the source of the electromagnetic field involved. It may be obtained as shown by utilizing the electromagnetic stresses set up by a wire conveying electrical energy or on a small scale from permanent magnets. The essential fact, however, is that by forcing a wire through a region of electromagnetic stress, electromotive stresses are set up in that wire, the action in every case being in such direction as to compel us to do work on the wire. This work appears as electrical energy in the circuit including the moving wire.

(To be continued.)

Electrodynamic Machinery—XVI.

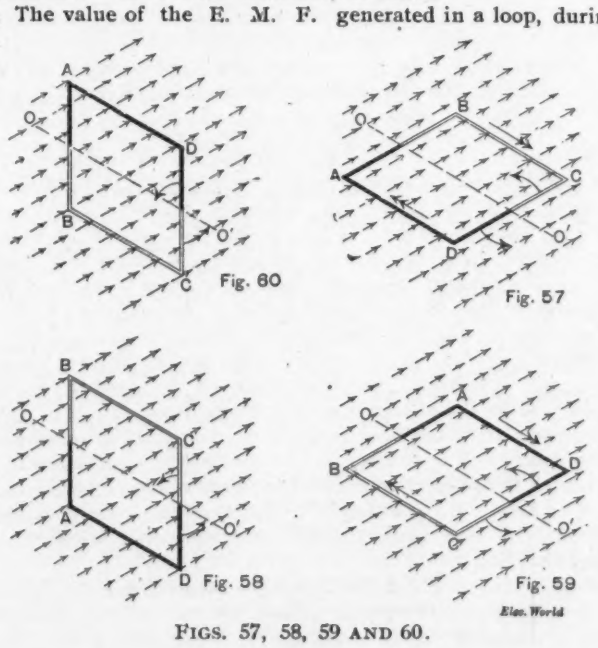
BY E. J. HOUSTON AND A. E. KENNELLY.

80. Let us consider the case of a square conducting loop A, B, C, D, Fig. 57, having its plane parallel with the uniform magnetic flux shown by the dotted arrows. If this loop be rotated about the axis OO, which is at right angles to the magnetic flux and symmetrical with regard to the loop, so that AD descends, and BC ascends, these sides, which cut flux during the rotation, will have E. M. F.'s generated in them, in accordance with Fleming's hand rule already described in sec. 70, and in the direction shown by the double arrows. The sides AB, and DC, which do not cut flux during the motion, will add nothing to the E. M. F. generated. The figure shows that while the sides AD and BC, have oppositely directed E. M. F's, yet regarding the entire loop as a conducting circuit, these E. M. F's tend to produce a current which circulates in the same direction.

81. As already pointed out, the value of the E. M. F. generated in the sides AD and CB of the loop by the cutting of the flux, will depend upon the rate of filling and emptying the loop with flux, and it is evident that this rate is at a maximum when the loop is empty, *i. e.*, in the position it occupies in Fig. 57, when the plane of the loop coincides with the direction of the flux, and the motion of its sides is at right angles thereto; for, when the loop reaches the position shown in Fig. 58, namely, when it is full of flux, *i. e.*, when its plane is at right angles to the flux, then at that instant the rotation of the loop neither adds to diminishes the amount of flux enclosed, so that the E. M. F. in the loop is zero.

82. Continuing the rotation of the loop in the same direction, the E. M. F. generated will increase from this position until the position shown in Fig. 59 is reached, where the plane of the loop is again coincident with the plane of the flux, but in which the side AD, has moved through 180°, or one-half a revolution from the position shown in Fig 57, and the directions of E. M. F's in the wire, as shown, will be changed so far as the wire is concerned, being now from A to D, instead of from D to A, in the conducting branch AD; and from C to B, instead of from B to C, in the conducting branch BC. The direction of E. M. F. around the loop, will, therefore, be reversed. Consequently the loop ABCD, during its first half revolution as shown in Figs. 57 to 59, has an E. M. F. in the same direction; and, during the remaining half revolution, has its E. M. F. in the reverse direction, as shown.

83. The value of the E. M. F. generated in a loop, during its



Figs. 57, 58, 59 and 60.

rotation depends upon the flux density, the area of the loop, and the rate of rotation.

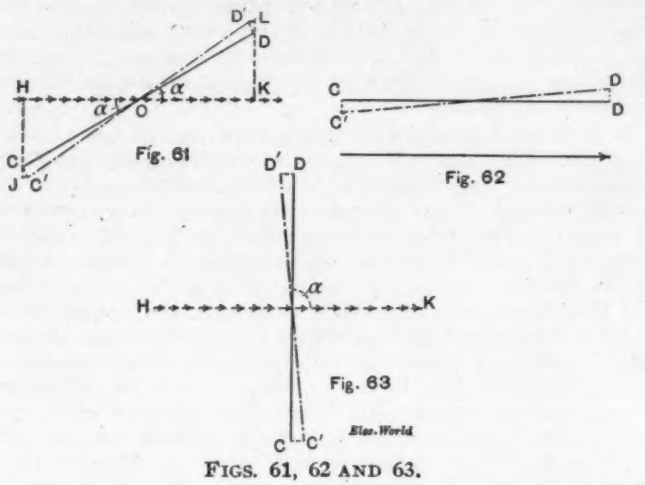
Assuming the side of the loop CD, to occupy the position shown in Fig. 61, making an angle, with the direction HK of the flux, then the E. M. F. generated in the loop at this instant is the rate at which flux is being admitted into the loop. If l cms., be the length of the side of the loop or the length of AD, in Fig. 57, the amount of flux embraced at this instant will be $l \mathfrak{B} \times 2DK$. During the next succeeding small interval of time dt, if the angular velocity of the loop, ω radians per second, carries it to the position C'D', the amount of flux admitted during that time will be $l \mathfrak{B} \times 2DL$. But $DL = DD' \times$ cosine of angle D'DL, and its

angle is equal to the angle a, so that $DL = DD' \times \cos a$ DD' will be $\frac{l}{2}\omega\, dt$ cms. in length, since the radius $OD = \frac{l}{2}$; consequently, the flux admitted into the loop during this brief interval of time dt, will be

$$d\Phi = 2\,l \times \frac{l}{2}\,\mathfrak{B}\,\omega \cos a\, dt, \text{ or } l^2\,\mathfrak{B}\,\omega \cos a\, dt$$
$$= \Phi\,\omega \cos a\, dt$$

so that
$$\frac{d\Phi}{dt} = \Phi\,\omega \cos a$$

and thus, the instantaneous rate of increase in the flux at the instant



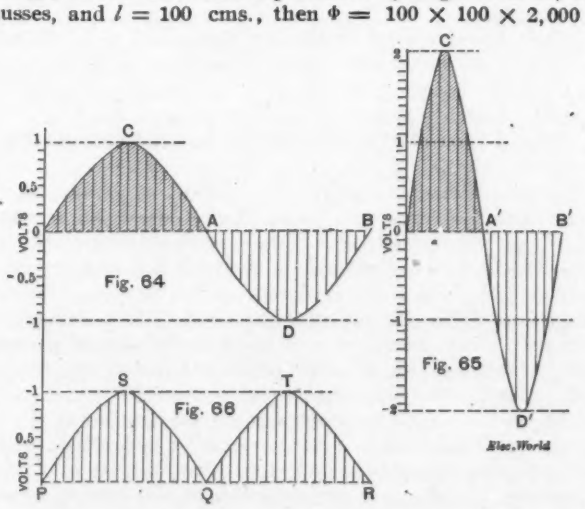
FIGS. 61, 62 AND 63.

of time in which the loop has reached the position OD, and if a be the angle which the loop includes at any time with the direction of the flux, the E. M. F. e, will be generally expressed in C. G. S. units by

$$e = \Phi\,\omega \cos a$$

Φ being the maximum amount of flux in webers ($l^2\,\mathfrak{B}$), which the loop can embrace. When the plane of the loop coincides with the direction HK of the flux, as shown in Fig. 62, DD', is brought into coincidence with DL, or the cosine of a is 1. So that the E. M. F. e, in the loop has a maximum value, and is equal to $\Phi\omega$, while when the loop is at right angles to the flux, or as shown in Fig. 63, DD', the succeeding small excursion of the loop, is at right angles to DL, or cosine $a = 0$, so that $e = 0$.

84. If $\mathfrak{B}'$, as in the case represented by Figs. 57 to 60, be two kilogausses, and $l = 100$ cms., then $\Phi = 100 \times 100 \times 2{,}000 = 20$



FIGS. 64, 65 AND 66.

megawebers. If the loop be rotated in the direction shown at an angular velocity of 50 radians per second ($\frac{50}{2\pi}$ revolutions per second), the E. M. F. e, will be

$$e = 20{,}000{,}000 \times 50. \times \cos a, \text{ or } 100{,}000{,}000 \cos a$$
$$= 1 \cos a \text{ volt}$$

85. The E. M. F. generated by the loop, therefore, varies periodically between 1, 0, —1, 0, and 1. If these values be plotted graphically as ordinates, to a scale of time as abscissas, the curve shown in Fig. 64 will be obtained, where the distance OA represents the time occupied by one half revolution of the loop, the E. M. F. being positive from O to A, and negative from A to B. If now, the speed of revolution be doubled, *i. e.*, increased to 100 radians per second, the time occupied in each revolution will be halved and O' A', Fig. 65, will be half the length of OA, but e, will be doubled as shown. The shaded area O'C'A', in Fig. 65, is equal to the area OCA, of Fig. 64. The E. M. F. generated by the loop is alternating, being positive and negative during successive half revolutions, but, by the aid of a suitable commutator, the E. M. F. can be made unidirectional in the external circuit, as represented in Fig. 66, where the curve PSA, corresponds to OCA, in Fig. 64 and QTR, to ADB.

(To be continued).

Practical Notes on Dynamo Calculation—XVII.

BY ALFRED E. WIENER.

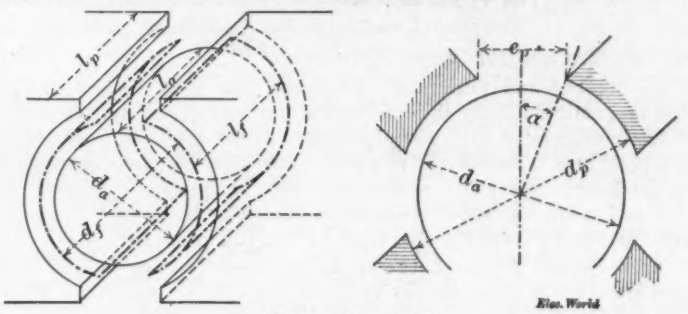
33.—Actual Field Density of Dynamo.

According to the definition given in section 31, the actual field density of a dynamo is the total useful flux cutting the armature conductors, divided by the area of the actual magnetic field, thus

$$\mathfrak{C} = \frac{\Phi}{A_f}, \quad \ldots\ldots(93)$$

where $\mathfrak{C}$ = Field-density, in lines of force per sq. inch;
Φ = Useful flux, in webers, from formula (91) or (92) respectively;
and A_f = Actual field-area, in square inches, *i. e.*, area occupied by the effective armature conductors.

This actual field density (93) is, in general, slightly different from the original field density, selected from Table IV, section 4, and used for the determination of the length of armature conductor, for the reason that, in practice, the length of the polar arc is not fixed with relation to exactly obtaining the assumed field density, but is dimensioned according to a construction rule having refer-



FIGS. 46 AND 47.

ence to the ratio of the distance between pole-corners to the length of gap spaces (see section 34).

It would be an easy matter to obtain the length of the polar arc and the percentage of its embrace from the assumed field density, for, supposing that, in a machine with smooth armature, the length of the pole pieces is equal to that of the armature core, we would simply have to make the sum of the lengths to the polar arcs of half the number of poles $= \frac{\Phi}{\mathfrak{C} \times l_a}$, or the percentage of the polar arc:

$$\beta = \frac{\Phi}{\mathfrak{C} \times l_a \times d_f \times \frac{\pi}{2}}, \quad \ldots\ldots(94)$$

in which

β = percentage of polar arc, or quotient of sum of all polar arcs by circumference of mean field-circle;
Φ = Useful flux, in webers, from (91) or (92);
$\mathfrak{C}$ = Assumed field-density, in lines per sq. inch, from Table IV;
l_a = Length of armature core, in inches, formula (12); and
d_f = Mean diameter of magnetic field, in inches, which is given by the core diameter of the armature, by the height of its winding space, and by the clearance between the armature-winding and the pole-pieces: $d_f = d_a + h_a + k_{13}$; see section 34.

But since the polar embrace so determined may not be within the limits of practical design in accordance with the construction rule referred to, it is advisable not to follow the process indicated by formula (94), but to fix the distance between the pole-corners, and thereby the percentage $\mathfrak{B}$, by that rule, and to calculate the actual field density corresponding to the same by formula (96) or (100), respectively.

This latter method is in no way objectionable, as the new, actual value of $\mathfrak{C}$ only enters the calculation of the magneto-motive force,

and the change does not affect any of the previous calculations concerning the dimensions and the winding data of the armature. For, according to formula (90), the same E. M. F. will be generated by a certain number of conductors moving at a constant speed, as long as the total useful flux remains the same; the E. M. F. generated by a certain armature, therefore, remains constant as long as the product of field-density and field area is kept at the same value, and it matters not whether this product is made up of the original field density and an area corresponding to the polar embrace found from formula (94), or of a larger actual density and a correspondingly reduced field-area.

(*a*) *Smooth Armatures.*

In *smooth* core armatures, Fig. 46, the area A_f, occupied by the effective conductors, is obtained from:

$$A_f = d_f \times \frac{\pi}{2} \times \beta' \times l_f ; \ldots\ldots\ldots\ldots\ldots\ldots (95)$$

the actual field-density, therefore, by inserting (95) into (93), can be found:

$$\mathfrak{K} = \frac{\Phi}{d_f \times \frac{\pi}{2} \times \beta' \times l_f}, \ldots\ldots\ldots\ldots\ldots\ldots (96)$$

where $\mathfrak{K}$ = actual field density of dynamo, in lines of force per square inch;

Φ = Total useful flux of machine, in webers, from formula (91) or (92);

d_f = Mean diameter of magnetic field, in inches;

β' = Ratio of effective field circumference, obtained from the percentage of polar embrace, β, by means of Table XXXII, section 20.

l_f = Mean length of magnetic field, in inches;

$l_f = \frac{1}{2}(l_a + l_p)$; l_a = Length of armature core, in inches;

l_p = Length of polepieces, in inches.

(*b*) *Toothed and Perforated Armatures.*

For toothed and perforated armatures, the area A_f, occupied, in the magnetic field, by the effective armature conductors, cannot be directly calculated from the dimensions of the armature core, since the path area of the actually useful flux cutting the conductors depends upon too many conditions as to be formulated satisfactorily, and it is, therefore, advisable to compute the actual field density $\mathfrak{K}$ directly from the electrical data of the armature.

According to chapter 1, the E. M. F. generated per foot of effective armature wire moving at a velocity of 1 ft. per second in a field of the density of 1 line p. square inch, is $\frac{72 \times 10^{-8}}{b}$ volt, if there are b bifurcations of the current in the armature.

For the total effective length of L_e feet of conductor moving at the speed of S feet per second in a field of density $\mathfrak{K}$, therefore, the E. M. F. generated is

$$E = \frac{72 \times 10^{-8}}{b} \times L_e \times S \times \mathfrak{K}, \ldots\ldots\ldots\ldots (97)$$

from which follows the field-density:

$$\mathfrak{K} = \frac{b \times E \times 10^8}{72 \times L_e \times S} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (98)$$

(To be continued.)

Notes on the Management of Railway Power Stations—VI.

BY GEO. T. HANCHETT.

The Switchboard.

The switchboard is the position of all the electric control of the station. In the design of a station where few men are in charge, it is always well to have it near the throttle and have no long runs in case of accidents. When trouble comes in an electric power station it comes like a flash and in an instant there is trouble everywhere. It requires a cool-headed man to do the right thing at the right moment and even then he should not be handicapped by a poor arrangement of the points of control. If a man, however good an electrician he may be, is not familiar with a switchboard, he should religiously let it alone in time of trouble. Matters may be made worse instead of better by turning a rheostat handle the wrong way or manipulating the wrong rheostat or switch.

The motoring of a dynamo sometimes occurs and is more apt to occur with a well designed series generator than one poorly designed. In the writer's opinion the excellence of the design of a compound machine, other things being equal, is inversely proportional to the number of series turns on its magnets. This being very small on a good generator the equalizer does but little toward preventing a machine from motoring. In fact, it is possible to successfully operate two compound generators in parallel with the equalizer disconnected, provided the series-turns are very few in number.

When a generator motors it is usually due to carelessness. The switchboard ammeter should be under sufficient supervision to detect the falling off of the load long before the generator has a chance to motor. If, by any chance the engine speed falls off or from some other cause the voltage of the generator falls, due to improper governing, the load will gradually come off the machine. While in this state the trouble may be corrected by the rheostat. If, however, the generator has started to take current from the bus bars, throw the double pole switch as quickly as possible. Build the machine up to voltage by means of the rheostat and throw it on again adjusting the rheostat till it takes its proper increment of the load.

In throwing a large machine on to a pair of bus bars on which is only one machine, have its voltage a little low rather than high; remember that if the capacity of the large machine is great that it voltage will become the bus bar voltage as soon as contact is made. If, therefore, the voltage of this machine is high the chances of motoring the smaller dynamo are exceptionally good even in spite of the equalizer.

A short circuit or heavy load is a most frequent source of trouble. If there is one generator in circuit and a short circuit occurs, the engine groans and thumps, the brushes spark furiously and emit a screeching sound, then the circuit breaker throws and then it means a good governor or a runaway. The whole occurs very quickly and is sure to confuse a man not familiar with such things.

The writer is heartily in favor of a circuit breaker, which, instead of throwing the circuit open will act like a double throw switch and will throw on to the generator a load say 50 per cent. of its capacity. This will save a strain on both engine and generator. Shunting the circuit breaker is another means of accomplishing the same end. The circuit breaker must in this case be set with the shunt in place, otherwise it is no protection. The shunt should also be so proportioned that on dead short circuit with the shunt in series and the circuit breaker open, the resultant load is not over the capacity of the machine, or, if there are several circuits, a proportional amount. It should be of material heavy enough to carry the full current load. A circuit breaker should be constructed with flash contacts. The arcing at opening will then be so slight at the real contacts as not to fuse them and possibly prevent its being effectively closed again.

The closing of a circuit breaker should involve four steps, in the following order.

1. Open the single pole switch on that circuit.
2. With a file remove any burs or burns on the contacts.
3. Close the circuit breaker and by pressing the trigger be sure that it opens readily and freely.
4. Finally close first the circuit breaker and second the single pole-switch.

If the circuit breaker immediately comes out again repeat the operations and, holding it in for an instant, read the ammeter and thus gain an approximate idea of how short the circuit is, and, if serious, send a man out at once. If the circuit breaker is shunted the ammeter will be a very accurate indicator of the magnitude of the trouble and the instant of its removal. The voltage at the cars in such a case would be very low and the motorman should be taught to recognize this as a sign of trouble and to cease to call for current from the line till the removal of the difficulty.

In the case of a thunder storm some managers think it wise to shut down and disconnect. If, however, it is decided to run, do not go near the switchboard any more than necessary. Rely on the arresters. Have an extra generator or two turning over at full voltage ready to take the load if a machine becomes disabled. The volume of a lightning discharge is seldom heavy after it reaches a machine. The great danger is the puncturing of the insulation and the grounding of the commutator and armature segments. The reactance of the field coils usually effectively protects them. If it is decided to shut down it is well to heavily ground the trolley systems. This will prevent, in a measure, the discharge going through motors or instruments.

It is well to thoroughly familiarize oneself with all the wires of a switchboard. It is not enough to know that rheostat No. 1 controls the field of machine No. 1. The man in charge should know just how and where the wires go. Such knowledge will be invaluable in time of trouble. It will give a quick comprehension on seeing the results of an accident on the switch-board as to its cause; and second, it will be especially valuable when it is desired to use

the switchboard instruments for experimenting or testing. Even in large and well arranged stations the switchboard instruments are often the only ones that the station manager has at his command, unless he possesses some of his own which he is willing to use in the company's service.

The well arranged switchboard has the following properties:—

The three-pole switch comprising plus, minus and equalizer is low down. It has its hinge below and not above This rule is very seldom followed. A switch if hung the opposite way may do untold damage by falling shut, whereas, if its hinge is below, the very slight tendency to fall open, if such could be claimed at all, is tenfold counteracted by the friction of the jaws. Of course heavy jack-knife switches have springs to hold them open, but these cannot always be relied on and the writer knows of several well arranged stations where the switches are propped open by sticks when not in use.

Another very common mistake is to place the circuit breaker last on the line as it leaves the switchboard. In the writer's opinion safety devices should be as near as possible to the source of power.

The first thing on the line after the bus bars should be the circuit breaker. Taking into consideration a simple circuit: it is possible for a short circuit to occur anywhere on the line, and if the safety cut out is located at the end of the line, it is worthless and it becomes of more and more value as its position approaches the dynamo, for it will only be operative when the short circuit takes place on the dynamo side of it. For this reason there should be at least a heavy fuse at the end of the rocker cables on the dynamo. The writer has encountered some cases where the equalizer wire has been fused. This usually does but little harm as the current in the equalizer is nil when all is working properly. If, however, the current in the equalizer is so strong that it will blow the fuse, that is the very time when the equalizer circuit should be intact even at the expense of the insulation on the wire.

The position of the instruments should be carefully chosen. The voltmeters should have a board to themselves, as they are liable to be in error by the presence of wires carrying heavy currents. The ammeters may be on the main switch board, but should be as far from heavy current wires as their nature will permit.

On the inverse principle of the circuit breaker the lightning arrester should be as far from the bus bars as possible. It is well to have a special board for them removed from the switchboard. They can then readily be inspected after a thunder storm, and the arrangement makes the main switchboard safer for the operators while the thunder storm is in progress. These changes are so slight and so easy to make that it is possible to materially improve the arrangement of the switchboard even after it has been installed.

Ammeter and voltmeter readings should be taken every fifteen minutes. From these the daily load curve can be plotted and it will be of great value in economically operating the station. In reading the instrument take neither the highest or lowest reading, but the mean of the two. If the load is very high wait an instant; it may be a sudden pulse of current which will not come again. Such a reading would have but small value to the engineer studying the load and would tend rather to mislead.

It is well to note the voltage when a single machine is operating and by comparing it with the current load determine whether the machine overcompounds as rated.

Compound machines are of little value when run in parallel as far as regulating the potential to a constant point is concerned, for different combinations of dynamos will give different potentials at exactly the same load even though they are all adjusted to the same loss. Their merit lies in the fact that the potential rises when the load comes on and even though it does not compensate, as it should for the loss in the line, it tends to improve matters. This applies to power only. In the case of lighting this property, as Prof. Roberts has shown in a recent article, is very prejudicial to long lamp life.

It sometimes happens that the rheostat of a machine is obliged to be turned as far as it will go on a heavy load. Theoretically it should not need to be turned at all, but practically it needs some adjustment on account of the increased resistance of warm field coils. In case of this adjustment being beyond the range due to incorrect compounding, adjust the shunt on the series coils, increasing its resistance.

Bear in mind that the shunt on the series coils is to be let alone unless the compounding of the series is wrong, or it is desired to alter it. Mere drop of voltage should be adjusted by speeding the dynamo.

All parties except those specially privileged should be excluded from the dynamo room. Aside from the inconvenience the vandalism of some people is beyond belief. The writer knows of one case where the rules were somewhat slack. As a result on one occasion the management found nails driven in the field magnets, sand in the oil, and the bus bars heavily short circuited.

Great mistakes are made in the installation of fuses. It is possible by using a short fuse with heavy terminals to practically double its capacity in which case its value as a safety device is gone.

Paint all cables in and about the switchboard with an insulating paint. There will always be trouble enough about grounds and short circuits on the line, and there is no excuse for them in the station. Never place lightning arresters in a wire tower or near where the feeders leave the switchboard. The arrester should be placed so that it is impossible for the discharge to find any path except through the ground circuit provided for it.

The switchboard should be well lighted both in front and behind especially the measuring instruments. Five lamps is none too many, even for a single panel. Don't rely on the general illumination of the station. The switchboard should have every convenience for the rapid detection and immediate removal of faults.

Remember that the ground is one of the dynamo terminals; therefore keep all bolt Leads or other methods of attaching to the switchboard as far as possible from switch jaws and circuit breakers, and when they are necessary at those points, insulate them fully. The arcs that occur on a 500-volt switchboard are not small and they are quick to take advantage of such defects.

(To be continued.)

Fly-Wheel Accidents—II.

BY J. J. FLATHER.

Subsequent events showed that the commutator of the generator driven by this engine sparked badly, and was soon enveloped in a circle of fire and "looked as though red hot." The engineer pulled out the circuit breaker on the generator and the engine immediately speeded up; he started back to shut the throttle, but by this time the engine was racing at a very high speed (as shown by the force of the explosion) and he was barely able to close the valve when the wheel went to pieces.

While closing the throttle a sharp report was heard at the generator, and it was at this time, probably, that the dynamo pulley exploded, followed by the breaking of the belt and bursting of the fly-wheel. The excessive rim speed (not less than 9,660 feet per minute at time of rupture) had given a tremendous energy to the heavy wheel, which continued its speed even with a closing throttle. Under these conditions the wheel either parted from the influence of centrifugal force alone, or the piling up of the belt or other obstruction in the wheel pit might have produced a shock which was sufficient to cause the wheel to let go. This may also account for the lifting of the shaft from the out-board bearing and the breaking out of the front of the main pillow block, which was shown to have occurred.* Another case worthy of note is the accident which occurred at Lynn, October, 1890. This attracted much attention at the time, as the case was complicated by a fire. It will be remembered that twenty-three insurance companies were sued by the Lynn Gas & Electric Light Company, which was awarded the full amount claimed for wreckage of the building and machinery. The testimony seemed to indicate that a fire in the tower of the station caused a short circuit by enveloping the plates of the lighting arresters in flame, and possibly expanding them so that they came in contact. It was claimed† that this short circuit was brought on so suddenly that it broke the pulley on the jack shaft operating the dynamo then in use, that pieces of this pulley hit others, and according to one phase of the theory, one of the pieces broke off a ball of the governor, so that the engine ran away and caused the damage. Another phase assumes that the jar due to breaking the first pulley caused the next one to break, and that the next, and so on from pulley to pulley until the jack pulley was thus broken; then portions of the pulley were carried by the belt under the fly-wheel and broke that, thus completing the wreck.

Numerous other examples might be given to illustrate the same point, but the foregoing will show that the receiving pulley instead of a defective governor may be primarily responsible for some of the accidents which happen. In order to obtain greater safety in the receiving pulley we frequently find built up wood-rimmed pulleys on a combination of wrought iron or steel and cast iron employed for such wheels.

*"Power," November, 1893.
†E. C. Emery in Cornell Lecture, abstracted in "Power."

Considering the frequency of fly-wheel explosions it becomes an important question how to prevent them.

The history of fly wheel accidents has shown that the governor should not be the sole reliance for safety. It may have been safely depended upon for years, but just at the critical time, when most needed, it has shown itself unequal to its duty. Independent detaching apparatus for automatically shutting down the engine when a given speed is reached, should be employed in addition to the regulating governor. The safety device for preventing admission of steam into the cylinder when the governor balls drop below a given position, is too frequently inoperative, as under the variations of load thrown upon the engine the attendant may, in order to keep his engine running place the stop pin in the usual position for shutting down, so that the balls are thus prevented from falling in case a belt breaks, for instance, and the safety element is lacking. Under these conditions, which are by no means uncommon in electric power service, we are dependent upon the integrity of the governor belt, or gears, to prevent the engine from racing. In case the belt slips or is thrown off, or a pin or key becomes loose and drops out, the engine may speed up considerably above its normal rate before the engineer could close the throttle.

To guard against such an accident by reason of the governor belt failing, ropes are sometimes used intsead of belting. Two ⅞-inch ropes either of which will be ample to drive the governor, will take up no more space than a 3-inch belt and give a double security.

Many accidents which have occurred might have been prevented had there been some means at hand for shutting off the steam more rapidly than is provided in the ordinary screwed throttle. For this purpose there have been used, very satisfactorily, plain butterfly valves placed above the throttle, suitably counterweighted and arranged to be closed by releasing a spring in case of emergency. The precaution of using a magnetic or mechanical stop adopted in many factories, by which the engine may be promptly shut down from any part of the building, might be advantageously applied to a power station where the push buttons could be located near the switchboard and at other convenient points.

Of these the Hatch automatic stop is one of the most successful that the writer has seen in operation, and is admirably adapted to its work.

This consists of a spring operating a train of gearing ending in a sprocket, which is connected by means of a chain with a similar sprocket on the stem of the throttle valve. The engineer, in opening the valve, winds up the spring, which is restrained from action by a detent engaging with a notched wheel. This detent is controlled by a magnet, which may be operated from push buttons placed about the building as required. When the detent is withdrawn the spring rotates the sprocket through the gears and closes the throttle.

One advantage of such automatic closing devices is that the engineer is not exposed to the danger which he incurs when attempting to close down the throttle of a racing engine.

For several years past, since the beginning of fly-wheel accidents in electric railway service, builders have been striving to obtain a wheel better adapted to the trying and severe conditions imposed upon them by the high peripheral speeds and fluctuating loads. Rim and arm sections better proportioned to prevent dangerous shrinkage strains, double sets of arms for wide belts, and better design in the fastenings of sectional wheels have done much to increase the strength of fly-wheels, but even with these improvements there appears to be too small a factor between the working and breaking loads.

Racing is always possible on any engine, and every fly-wheel should be built with such a large margin of strength that it may withstand safely any reasonable excess of speed or sudden shock.

That wheels may be run at speeds greatly in excess of those commonly employed, is evidenced by the fact that cast iron fly-wheels (suitably strengthened by wrought iron or steel rods connecting the rim segments with the hub), are in successful operation at speeds of 7,500 ft. per minute. In saw-mill machinery the speed is even is even greater, approximating, in some cases, 11,000 ft. per minute.

Moreover, in the Howell torpedo adopted by the United States Government, the 14-inch fly-wheel runs at a peripheral speed of 36,660 ft. per minute, while in a larger type of similar torpedo, manufactured by the Hotchkiss Company, the velocity of the 18-inch wheel employed is 42,360 ft. per minute. Before leaving the shops these wheels are run up to a speed about 20 per cent. faster. Such test is not for flying to pieces, but only for the elastic limit, and the wheel must show no deformation after it.

It may also be pointed out that the steam wheel in the Laval urbine, running at 30,000 revolutions per minute, has a peripheral speed of 34,500 ft per minute, although, having regard to the apertures cut in it, this wheel cannot be nearly so strong as a solid one. In the Parsons turbines the 27-inch low-pressure wheel, running at 5,000 revolutions per minute, has a peripheral speed of about 35,400 ft. per minute, though this also has holes in it and is a thin disc which would not stand as great a strain as a solid cylinder. Further, these Parsons wheels have been run, experimentally, at speeds greatly in excess of that given, and they do not appear to show deformation until nearly twice their normal speeds are reached.*

The advantage of employing solid steel cylinders, say 3 ft. in diameter and 3 ft. wide running at 4,000 revolutions per minute, has been suggested by Mr. A. C. Swinton.†

This corresponds to a surface speed of 38,000 ft. per minute, and would store sufficient energy to maintain 66-hp for two minutes with a 5 per cent. variation of speed. If these wheels run at speeds varying from 35,000 to 40,000 ft. per minute, is it not possible to obtain a greater degree of safety than now obtains in fly-wheels which run at less than 6,000 ft. per minute?

To obtain immunity from disaster, which is liable to happen when a fly-wheel is subjected to excessive strains, especially in those cases where shock may occur due to sudden increase of load, it would seem that cast steel or built-up plate pulleys would give the desired degree of safety.

The fact that cast iron has properly no elastic limit, makes it particularly liable to rupture by violent shock, as there is little give to the material when placed under sudden increased strain. On the other hand cast steel is very well suited for such work. When low in carbon (20 to 25 per cent.) the elongation will be about 20 per cent., which is increased to 30 per cent. by annealing; the strength of such steel will vary from 65,000 to 70,000 pounds per square inch. A cast steel fly-wheel, especially if built up, ought then to be from three to four times as strong as a similar cast iron wheel. In the design of large built-up wheels with wide faces, in order to obtain the requisite strength, a greater weight is usually given to the wheel than is necessary for steady running.‡ As an instance of this, Mr. Manning states that with a weight of rim in his wooden rimmed wheel of 32,000 pounds, the speed was very steady and the weight was ample. In the old wheel which it replaced there was about 74,000 pounds. This suggests an additional advantage in the employment of steel which would allow the use of lighter wheels if desired. The lost work due to friction in the shaft bearings would thus be lessened and the relative cost of the wheels would not be as great. The expediency of reducing the weight of pulleys for electric railway service, is, however, doubtful.

Among the special forms of fly-wheels which have been built with a view of obtaining greater safety, may be mentioned those in use at the Mannesmann Tube Works in Germany and Wales. These fly-wheels are run at very high speeds and their rims are wound with wire under tension, in a continuous coil.

The wooden rimmed wheel designed by Mr. Manning to replace the cast iron one which went to pieces in the Amoskeag Mills, Manchester, N. H., three years ago, is a good illustration of special construction. This wheel is 38 ft. in diameter, 9 ft. face, and cost about $7,000, including patterns and special appliances; or less than the cost of the cast iron wheel which it replaced.

The rim is 12 inches thick, made of Western ash plank, laid up in 44 courses or rings arranged to break joint, and securely fastened by lag screws and through bolts. The arms (twenty-four in number arranged in two sets) are of cast iron suitably bolted to the rim and hub. The weight of wheel is estimated at 52 tons, of which about 16 tons is in the rim. It has been run at a speed of 7,200 ft. per minute without sign of deformation. Mr. Manning states that the strength of the rim is 10.58 times that of the cast iron wheel which it replaces, assuming the latter to be sound, and hence it can safely be run at a speed equal to $\sqrt{10.58}$, or 3¼ times greater. Several large cast iron fly-wheels have been replaced at the Amoskeag mills since this first wheel was constructed; others have been built to replace fly-wheels which have given way in other mills. Among these may be mentioned one 28 ft. in diameter by 110 inches face, with three sets of arms made for the Willimantic Linen Company, and one 30 ft. diameter, 60 inches face, for the Nashua Manufacturing Company. It is the impression of the writer that such a wheel was built for one of the Lawrence Mills also.

While in Manchester recently, investigating the subject of fly-

*The "Electrician," Aug. 31, 1894.
†"Proc. British Inst., [C. E., Vol. cxii."
‡Trans. A. S. M. E." xivi.

wheels and pulleys, the writer was shown a form of wheel designed by Mr. Manning for a 1,500-hp compound engine, which suggests possibilities of special advantage in electric railway and other work where the load is variable, and an accummulator, such as Mr. Swinton suggests, would be desirable.

This wheel is 14 ft. in diameter, with a rim 30 inches face, and 12 inches deep, of plate steel, each plate being ½ inch thick, 30 inches wide, and of a length equal to half the circumference. This mass is riveted together so as to break joints, and bolted to cast iron arms. The weight of the rim is about 50,000 pounds and its circumferential speed 4,100 ft. per minute, which allows a very large factor of safety. With suitably designed cast steel arms low in carbon, such a pulley could be run regularly at double the speed and be practically indestructible if the connections were of ample strength, as it would be well able to withstand any sudden shock liable to be imposed upon it, as well as centrifugal strains acting in the rim. A more radical departure from existing methods in fly-wheel construction is shown in the design by Mr. F. P. Sheldon, of Providence, for the dynamo fly-wheels or accumulators used in the station of the Union Railroad Company, Providence.*

The armatures for these generators are keyed direct to the engine shaft, and the fly-wheels, which act as regulators only, are keyed to the same shaft. The design is novel in that it has no arms, but consists of a hub, disc and rim, the two latter being made entirely of wrought iron. The diameter of the wheel is 18 ft.; the rim is 15¼ inches wide and 16 inches deep, made up of segments of 1⅜ inch and 1⅛ inch plate, assembled so as to break joint with the central web plates, which are 1 inch thick. These plates are cut in 60 degree sections, and two thicknesses riveted together so that the central disc is 2 inches thick; the disc is re-inforced about the hub by two other circles similarly constructed, making the thickness 4 inches up to a diameter of 9 ft.; 1½ inch countersunk head rivets are used in this work, fitted into reamed holes and headed up cold. The hub is of cast iron in two pieces, which are bolted to the web by 2½-inch through bolts. The weight of the wheel is about 40 tons and its peripheral speed 5,650 ft. per minute; the combined weight on the shaft, including cranks, armature and fly-wheel, is estimated at 78 tons.

The fact that perfectly safe pulleys have been thus constructed for special cases, would indicate that whenever engine buyers are ready to pay for the increased safety, engine builders will be ready to furnish the wheel.

It may safely be asserted that fly-wheels will continue to break even with the greatest care used to prevent such disaster; but with the precautions that may be taken such accidents should be rare.

*"Power," April, 1894.

Fly-Wheel Accidents in Power Houses.

To the Editor of The Electrical World:

Sir: Apropos of the discussion now going on in your columns concerning fly wheel accidents, I should like to say a few words.

There are but three ways in which the wheel can fail, namely, tension in the rim, bending strain in the arms, and shearing of the arms from either the rim or hub. The first of these can only be due to centrifugal force caused by excessive speed. Failure in either of the last two ways is the result of suddenly changing the load in the engine, or if the wheel is also used to transmit power, it may be caused by an excessive, although gradually increasing load.

Of course it is exceedingly unlikely that this last method of failure will occur in practice, and there is absolutely no reason why the wheel should fail in any manner but the first, if it is properly designed. If it does, it is the fault of the maker and cannot be blamed upon the circumstances to which the wheel is liable. Now if from any cause the engine races, so that its speed is double, say, it is not the wheel's fault if it bursts. It is an exceptional thing, which the wheel is not expected ever to meet. But there is no excuse for its not being strong enough to withstand all loads that the engine can throw upon it with an ample factor of safety, say four or five. In all cases of fly wheel accidents that ever came to the notice of the writer, the wheel burst either from excessive speed or from some hidden flaw or bad design.

A fact that frequently seems to be lost sight of is, that initial strains are often placed upon the metal in casting, which allow a very small margin of strength. The amount of this is very difficult to determine, but in a poorly designed wheel may be sufficiently great to tear away the arms from the rim when it is cast in one piece. The moral would seem to be to make the wheel in several sections. The bolted joint in the rim may be made as strong as any other portion.

If the spokes are made with an elliptical cross section, as they usually are, the greater resistance to bending is obtained.

In view of the above, which the writer believes to be the facts of the case, it would seem that although fly wheels made of other material than cast iron, and in other shapes, might be better than one ordinary fly wheel, still there is no excuse for the latter's bursting, except from the exceptional cause of excessive speed.

Mamaroneck, N. Y. ARTHUR J. FARNSWORTH.

To the Editor of The Electrical World:

Sir: In an editorial in your issue of November 10th on fly-wheel accidents, it is stated that the strain produced by the sudden imposition of a load and consequent sudden change of speed, is in the nature of a shearing strain as far as the rim itself is concern and of such an order as to be entirely negligible. Elsewhere in the same editorial it is stated, "if weakest at the junction of the rim the arms may thereby be sheared at the rim." Is this not a contradiction?

Boston, Mass. ENGINEER.

[There is no contradiction between the two statements. If a fly wheel is suddenly slowed the tangential stress in the rim due to change of momentum is greater at the outer than at the inner circumference of the wheel, which stress tends to shear the rim around an intermediate circle, or to separate it into two concentric portions. If we imagine a wheel that has been re-inforced by an outside rim held by longitudinal keys, the stress tending to shear the keys is the same that in a solid wheel is equally distributed along circles within the rim, and which, concentrated at the junction of the arms with the rim, where it is greatest, tends to shear these, as referred to in the second statement quoted. The first effect is of course entirely negligible, and was merely referred to in connection with a statement made in the letter under comment—ED.]

Signalling Through Space.

To the Editor of The Electrical World:

Sir: I observe in your No. 19, Vol. XXIV, a note signed "E. A. Grissinger" bearing the above title, and describing a case in which the telegraphic transmission of Morse signals over a telegraph line from Harrisburg to Baltimore was heard in a telephone on a short earth completed circuit extending parallel to another telegraphic circuit running in a direction opposite to that of the Baltimore line.

Mr. Grissinger says: "Induction probably takes place from one telegraph line to another, and then eight miles away the induced current on the telegraph line influences the short telephone line."

Such occurrences are not infrequent in telephony. While no doubt the second translation from the Harrisburg-Pittsburg line to the telephone was inductive, it is much more probable that the first, that from the Baltimore to the Pittsburg telegraph circuit resulted from actual conduction, either by reason of a high or relatively high resistance in the common earth wire at Harrisburg; or else, by reason of surface leakages across supports, on some portion of the route in Harrisburg city or telegraph office, such leakage being attributable to defective insulation.

Boston, Mass. THOS. D. LOCKWOOD.

Central Station Book-keeping.

To the Editor of The Electrical World:

Sir:—I noticed in the review of my book on "Central Station Bookkeeping" that criticism is made on the great amount of paper folded in some of the forms. I am exceedingly pleased to have this point so well brought out, as it affords a chance to state the reasons for encumbering the work with so much apparently useless paper. The point made in the review that the "last ten months' rulings of form 56 'Meter Customers' Register might have been safely left to the imagination of the reader," was fully considered, but in the light of actual experience of the writer in omitting just such parts, and from the fact that but comparatively few bookkeepers are familiar with the style of ledger, and from the further fact that it was expressly desired to call attention to the style of arranging the order of the months to aid in the transfer of amounts from page to page, it was finally decided to add the extra paper, thinking that a little more paper, to make the matter plain, would be better than to run the least risk of not being plain enough.

New York, N. Y. HORATIO A. FOSTER.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Thermo-electric Force of Electrolytes.—The Lond. "Elec.," Oct. 26, abstracts briefly from "Nature," a paper by Mr. Bagard from the "Ann. de Chemie et de Physique" for September; among other things he finds that in all cases the thermo-electric phenomena, the Peltier effect and the Thomson effect, gave results in case of electrolytes similar to those obtained with metals.

Di-electric Power of Ice.—In a recent academy paper by Mr. Piot, the results involved an error, pointed out by Mr. Blondlot; "L'Ind. Elec.," Oct. 25, contains the corrected results; the same issue contains Mr. Blondlot's paper abstracted in the Digest last week.

Induction in Cables.—In "L' Eclairage Elec.," Oct. 13, Mr. Guy gives a method by which the influence of an iron armature of a cable on the induction in the cable can be calculated in a comparatively simple way, if the magnetic qualities of the iron are known.

Vacuum Tubes.—In the Lond. "Elec. Rev.," Oct. 26, Mr. Allingham states that vacuum tubes can be lighted brilliantly by touching them against one terminal of a ¼-inch spark coil; one terminal of the coil lights it more brilliantly than the other and this terminal is the same when the battery connections are reversed.

Origin of Earth Current.—In the abstract in the Digest last week under this heading, the clause in the last line "in a clear atmosphere" should read "with a pressure of one atmosphere."

Earth Currents.—In the Lond. "Elec. Rev.," Oct. 26, Mr. Walker abstracts the paper of Mr. Palmieri, mentioned in the Digest last week, and adds some results of other investigations.

Surplus and Deficit Theory of Electricity.—The Lond. "Elec. Eng.," Oct. 26, contains the first part of an article by Mr. Maycock, in which he describes the theory in which the positive and negative electrifications are considered as representing an excess and a deficiency in the quantity of electricity.

A New Phenomenon.—The Lond. "Elec. Rev.," Oct. 26, gives a brief resume of the experiments of Mr. Lehmann described in the Digest, July 14.

MAGNETISM.

Earth's Magnetism.—An abstract of a French Academy paper by Mr. Tillo, in which he deduces the constants for four periods of this century and draws conclusions therefrom, is published in "L' Ind. Elec.," Oct. 25.

Magnetic Properties of Asbestos.—Mr. Hancock, in the Lond. "Elec. Rev.," Oct. 26, states that he has tried, but has failed to prove that asbestos is magnetic, as stated by Mr. Swinton in the Digest, Sept. 29 and Oct. 27.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Self-induction.—A German translation of the paper by Dr. Toebler, from the French, mentioned in the Digest, is published in the "Elek. Zeit.," Oct. 25. He describes the method of Maxwell and its modifications; the chief objection to this is the uncertain deflection of the needle near the zero point, due to the fact that the condenser and the self-induction "paralyze" each other mutually, and also that with coils containing much iron there is always a deflection to one side, followed by an uncertain movement to the other. From a large number of measurements made by him he used the method described by Kempe in his "Handbook," which method he describes in detail, adding some minor modifications suggested by himself; among these are that for accurate results measurements must be made with both the closing and the opening current; in the selection of the galvanometer it is very important that its damping is sufficiently great and that the movement of the needle should be sufficiently slow to read the throw of the needle with sufficient accuracy; the d'Arsonval galvanometer would answer the first but not the second condition, and he recommends an astatic Thomson or Siemens galvanometer, especially the latter; the use of mercury for the closing key and the commutator is essential for obtaining the same result with the closing and the opening current. The method consists of a Wheatstone bridge in which the self-induction together with the resistance, forms the fourth arm of the bridge; after obtaining a balance for continuous currents, the battery key is opened and the throw of the needle noted; the self-induction is then replaced by a shunted condenser, with which the measurement is repeated; the self-induction is then equal to the capacity of the condenser multiplied by the square of the resistance shunting the condenser, multiplied by the ratio of the two deflections; under the condition that the resistance in the fourth arm o the bridge is the same in both cases; if the capacity is in microfarads and the resistance in ohms, the self-induction will be in henrys, if the result obtained is divided by one million. He gives a diagram showing the connections for making the test with the usual apparatus and works out several examples. He concludes that this method gives sufficiently accurate results if attention is paid to the points which he mentions. (His measurements appear to refer only to coils and magnets used in telegraphy and telephony.)

Photometry.—A translation of a paper by Mr. Broca from the "Jour. de Physique," 1894, is given in abstract with illustrations, in the Lond. "Elec.," Oct. 26; the title is "Theoretical and Experimental Investigations on the Visual Sensations and in Photometry." He attempts to discover the law of the differential sensitiveness, which is of considerable practical interest in photometry in connection with the best length for a photometer bar. He gives a verification of the Fechner hypothesis; he shows that the sensations of the two eyes are added, and investigates the differential sensitiveness of the eye as a function of the intensity, deducing the law connecting the sensation with the excitation. In studying the degree of accuracy of a photometer, Boguer and Masson give the law that the ratio of the smallest perceptible difference to the total intensity is a constant; Helmholtz has shown that the differential sensitiveness passed through a maximum; the present author undertook similar experiments supplemented by photometric measurements and comes to the practical conclusion that for good photometric work one must work with an illumination of about one carcel-meter (approximately one foot-candle), the observer being about 12 in. from the fields under observation; he shows that it is necessary to have "a perfect symmetry of the beams in regard to the normal to the diffusing surface," and that nothing can be settled about the equal brightness of two fields which are not lighted by beams of the same angle of incidence; most of the errors of photometry he believes are due to the observer moving his head, thus changing the relative positions of the head and the illuminated surfaces. His conclusions are, that the conditions which an accurate photometer should fulfil are: it should be adapted for binocular vision, it should be arranged so that the observer's eyes should always be in a clearly defined position and it should be arranged to be worked with the sources of light changed over when a double measurement is impossible (by the former he means exchanging the positions of the lights and by the latter he apparently means to use a secondary source with which the standard and the unknown light are both compared). He shows that the figure of merit of a photometer has no meaning unless the illuminations of the screen are given; he finds that there is a wide range of illuminations over which the sensitiveness does not differ, but he believes it begins to diminish again under higher illuminations than one foot-candle. In an editorial mention it is stated that a dazzling illumination did not appear to disturb the sensitiveness until 10 to 15 candle-feet were reached.

Photometric Units and Quantities.—In "L'Ind. Elec.," Oct. 25, Mr. Hospitalier suggests a set of symbols for each of the photometric quantities in the system recently suggested by Prof. Blondel (see Digest, Aug. 11, 25, Sept. 22, Nov. 3). As Roman letters have been reserved for abbreviations of the units, Italian and Greek letters for geometric, mechanic and electric quantities and script letters for the magnetic quantities, he suggests using for the photometric quantities bold-faced letters, sometimes called antique or Gothic, like those used by the English for the magnetic quantities. In French six of the seven photometric quantities begin with a different letter and the seventh, intrinsic brightness, is not of sufficient importance to require a special letter, as it has the same dimensions as illumination; he therefore uses the initial letters which are as follows: **I** for luminous intensity, **F** for luminous flux, **E** for illumination and intrinsic brightness, **R** for intrinsic radiation, **L** for lumination or quantity of illumination and for quantity of light or lighting. He asks for discussions of his suggestions.

Measuring the Degree of Incandescence of Lamps.—A translation of a paper by Mr. Crova from the "Comptes Rendus," No. 16, Oct. 15, is published in the Lond. "Elec.," Oct. 26. He shows how the degree of incandescence in lamps can be accurately determined with a spectrophotometer and with sufficient accuracy by a method of his which was recommended by the Congress of 1889; he has shown that in a comparison of two lights of different colors their total intensities are the same as their intensities measured in the portion of the spectrum of a wave length of 582 and gives the proportions of a solution called the 582 solution, which makes the two sources of light identical in color, thus rendering the measurements more accurate; the method may be employed without any trouble. The degree of incandescence in the carcel lamp being taken as unity he finds that that of the arc lamp varies from 1.5 to

1.7 with a consumption of 1,509 and 1,660 watts respectively; for a 16-cp incandescent lamp this figure varied from 1.05 to 1.23, according to the degree of forcing of the lamp; more detailed figures are given for some gas burners including the Auer.

Localizing Faults in Submarine Cables.—In the Lond. "Elec. Rev.," Oct. 26, Mr. Rymer-Jones replies to the criticism (see Digest, Oct. 6) of his recent article (see Digest, Sept. 29). Any one using this method should read the original and his reply; the substance of the latter is briefly, that on board ship a zero method is certainly necessary, while on shore the condenser discharge method is preferable; his way of effecting the result in the zero method is different from the one described by Jamieson; he does not use Poggendorff's battery test for measuring the potential of the cable, as it has disadvantages that his method is intended to avoid; he thinks his method is free from certain drawbacks and he believes that it is novel in its application though not in its principle; he considers the marine galvanometer quite unsuitable for measuring the discharge from a condenser.

Hydrostatic Electrometer.—A description of a new absolute electrometer of Mr. Guglielmo from the "Zeit. fuer Instrumentenkunde," is abstracted very briefly in the Lond. "Elec.," Oct. 26. It consists essentially of a flat dish containing a conducting liquid and communicating with a burette; a truly horizontal metallic disk rests above the surface and when electrified it attracts the liquid and raises its level; to restore the level to its former position some of the liquid must be withdrawn, which quantity is weighed or measured, giving the difference of level and hence the electrical pressure; the level is indicated by a pointer touching the surface of the liquid; saline solutions or acidulated water are preferred to mercury.

Simple Electrical Method for Testing Dynamos and Motors.—In the article abstracted at some length under this heading in the Digest last week, an unfortunate typographical error occurred; in the second column, first page, fifteen lines from the top the expression "$D+E+W$" should read "$D \div E + W$."

Imperial Institute.—A lecture by Dr. Lummer on the objects and the work of the German Reichsanstalt, is abstracted at some length in the "Elek. Zeit.," Oct. 25.

DYNAMOS AND MOTORS.

Sine Curve Controversy.—Referring to the discussion in the American papers, an editorial in the Lond. "Elec. Rev.," Oct. 26, states that the question is obscured by the unfortunate confusion between the induction curve and its resulting electromotive force curve; the question cannot be answered in favor of one form over the others for all possible uses, as the requirements are somewhat antagonistic; it is not clear that the total core loss and any other smaller losses due to Foucault currents may not be increased by any considerable departure from the sine curve; such extra losses over that due to hysteresis would be very small; there can be little doubt that the presence of upper harmonics of large amplitude would be detrimental to power transmission, especially in respect to increasing the drop on inductive circuits and the wattless current in mains of large capacity; it may be questioned whether it is worth while spending much money in designing machines to give an absolutely perfect sine curve; probably no alternator in the market has a curve of induction differing much more than 10 per cent. from the sine curve, and it is questioned whether it is worth while trying to improve on this.

Alternators in Parallel.—In an editorial on the lighting of the city of London, the Lond. "Elec. Rev.," Oct. 26, advises that the parallel running of the Mordey alternators should be abandoned, as it has been found that the liability to a break down of the armatures is enormously increased by running the machines in parallel; the results obtained by running the machines separately have been most satisfactory.

Construction of Dynamos.—The long series of articles by Mr. Richards on the details in the construction of dynamos, which appeared in "La Lum Elec.," is being continued in "L'Eclairage Elec.;" it is profusely illustrated with excellent diagrams, taken apparently mostly from patent specifications.

ARC AND INCANDESCENT LIGHTS.

Continuous and Alternating Current Arcs.—An interesting article by Prof. Fleming is published in London "Lightning," Oct. 25. He gives the results of experiments made by him four years ago to determine the relative efficiencies. The voltmeter was connected to the two carbons, so as not to take into account the energy in the mechanism; for continuous currents the top or positive carbon was cored and the negative solid, while for the alternating both were cored; in order to eliminate the differences in color between the incandescent lamp standard and the arc, a screen consisting of a ruby red glass and one of signal green was used to cut off a given range of the spectrum; with the alternating current the measurements were difficult, as the light intensity seems to go through a regular cycle for three or four seconds, the arc appearing to revolve around the vertical axis; the observations numbered many hundreds and the results are given in the form of curves; from the results the wattages for the red and green rays were calculated; the arcs were run with different currents; curves are given for the mean spherical candle-power corresponding to different values of the power in watts, the curve for the red rays being approximately a straight line while that for the green rays bends upwards; results showed that for a given expenditure of power in the arc, the mean spherical candle-power for alternating currents is less than that for continuous current in about the ratio of 2 to 3, thus for 540 watts continuous current, the mean spherical candle-power of the red rays was 342 and of the green rays 686, whereas for the alternating current the values were 217 and 407 respectively. Observations for different powers with the alternating arc were not taken, but they are to be made and published soon. The alternating arc has an inductive resistance under certain circumstances, especially when hissing, and therefore a wattmeter must be used in measuring the power; the maximum intensity of the continuous current arc for different wattages does not always occur in the same direction. The general result shows that for a given amount of power to be converted into arc light it is more economical, as regards illumination, to use the continuous current. For the continuous current the maximum was at an angle of 40° with the horizon; for the alternating arc with 540 true watts, the maximum intensity was only 575-cp at 48° below the horizon; if the light directly available for lighting a floor space be taken into account, the efficiencies of the two arcs are in the ratio of 6 to 2 in favor of the continous current, a part of the light lost in the alternating arc may, however, be reflected downwards, but would never decrease the first mentioned ratio; such a reflector must be small and placed close to the arc; with continuous current arcs it is not absolutely necessary to have the positive carbon cored but with the alternating current both carbons must be cored; the alternating arc is never quite silent, but the noise can be controlled to a great extent by the quality of the carbon and the selection of the frequency; a further disadvantage is in the production of a lag in the current behind the voltage, thus increasing the current, which means a larger waste of power in other parts of the circuits; a rectified alternating current may prove to be well adapted for arc lamps owing to the pulsating character of the current.

New Incandescent Lamp.—Some crude tests of the "Quanonne" lamp, recently placed on the market by a Belgian firm, are published in the Lond. "Elec. Rev.," Oct. 26; in comparison with an ordinary incandescent lamp of 16-cp, the watts per candle were 2.43 as compared with 3.42 for the ordinary incandescent lamp; the question of durability remains to be determined, but judging from the appearance of the filament when working somewhat above the normal voltage, they do not appear to be overrun, and therefore should last a considerable time without blackening or any serious deterioration.

Electric Light for Photography.—In a short lecture by Mr. Kennedy, abstracted in the Lond. "Elec. Rev.," Oct. 26, he compares a forced incandescent lamp with the arc lamp and finds that the cost of the former would be about $1.25 per hour, while the arc lamp, as made by an English firm, would cost but 35 cents per hour; furthermore on account of the blackening of the incandescent lamp, a photographer can never count on absolutely the same light, which is not the case with the arc lamp.

Theatre Arc Lamp.—The Krueger lamp, intended to replace the calcium light, is illustrated and described briefly in the Lond. "Elec. Rev.," Oct. 26.

Shades.—Different patterns of plume shades representing different flowers, are illustrated in the Lond. "Elec. Eng.," Oct. 26; they are made of feathers of various styles and colors surrounding the incandescent lamps in the form of a shade.

Silvering Bulbs.—A recipe is published in the "Elek. Anz.," Oct. 21.

ELECTRIC RAILWAYS.

Three-wire System on Trolley Lines.—The system is editorially discussed in the "Elek. Zeit.," Oct. 25; the advantages are recognized and it is thought that the reason why it is not in use more than it is, is doubtless that its application is limited chiefly to double track roads and that one or the other of the trolley wires must be connected to the positive pole of the generator, which involves a more rapid deterioration of the trolley wire.

Canal Boat Traction.—"L'Ind. Elec.," Oct. 25, states that the recent experiments made with the Galliot system (described in the Digest, Nov. 3), in which the propeller is secured to the rudder, were very successful, both when run with accumulators and when run from a trolley line; the speed is greater and more regular and the cost of operation is less than with the older methods.

Accumulator Traction in Mines.—The Lond. "Elec.," Oct. 26, abstracts briefly a paper from the French by Mr. Libert, in which he describes two interesting applications of accumulators for underground haulage in two Belgian mines.

Overhead Railway.—The Lond. "Elec. Rev.," Oct 26, refers to the Hanlon system, described in The Electrical World, and calls attention to difficulties which would arise; it is claimed that the difficulties in crossings and switching will involve considerable more work and expense than might at first appear; no one of the new ideas and resurrections is "presented in a carefully considered form that can stand any real criticism as a going concern."

Liverpool Railway.—An article is begun in the Lond. "Elec. Rev.," Oct. 26, based apparently on the recent papers of Messrs. Greathead, Fox & Parker, and the discussion thereon; these papers and the discussion have been abstracted at some length in the Digest.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Electricity in Mining.—An article by Mr. Berthon is begun in "L'Elec.," Oct. 20; he gives a brief description of the installation at the Decizes mines, in which diphase currents are used, the motors being on the same type as the generators; the starting is said to involve no difficulties. He then discusses in general the best selections of the central station, the lines and the motors; he recommends among other things, high speed direct coupled engines; the voltage should not exceed 5,000, while 250 is preferable for certain kinds of machines; the continuous current can be used in mines in which there is no fire damp, while in the latter polyphase currents or safety motors are absolutely necessary; diphase currents are specially well applicable, synchronous motors for pumps, ventilators, etc., and non-synchronous motors for machines requiring to be started and stopped frequently, while continuous currents transformed from the diphase currents can be used for traction; for all transportable apparatus the voltage should not exceed 100. Under the heading of motors he says the sparking at the commutator has been shown to cause explosions if the commutator itself is warm; he describes a system in which the motor is completely enclosed, but the quantity of air enclosed is too great and an explosion may follow; in another method only the armature is enclosed; in another, illustrated with a diagram, the face of the commutator is made the inside surface of the segments, the brush extending from near the shaft out toward the inside surface of the commutators, the whole space being then enclosed with a joint impermeable to the flame of the fire damp; experiments with explosive gases have given satisfactory results; the only absolute safeguard is to use polyphase currents, the ideal motor being one in which the armature consists simply of a mass of iron, having no connection with the circuit.

Train Lighting.—The Lond. "Elec.," Oct. 26, gives the conclusions to which the General Electric Company of Berlin, have come regarding the simplest solution of the problem, which consists in the use of accumulators pure and simple; the system is used on one of the Government railways of Prussia about 60 miles long. A battery capable of supplying 5 lamps of 5-cp for 40 hours would weigh 467 lbs. if discharged at 15 volts, 516 lbs. at 22.5 volts and 591 lbs. at 30 volts; the capacity should have a reserve of about 10 per cent or more; as a rule 22.5 volts, requiring 12 cells, will answer best and at this voltage a battery for 5 lamps of 16-cp for 8, 12 or 16 hours, would weigh 443, 516 and 562 lbs. respectively; the cells are placed in cases not too heavy to be managed by one man; as regards comparative weights they state that a gas plant for 5 jets of 40 hours, weighs about 1,000 lbs., while the equivalent electric plant with a battery of 12 cells, weighs only 640 lbs.; they recommend changing the cells instead of charging them in place on cars; the state of the battery is indicated by voltmeters or by the simple Aubert hour-counter, but then only when the current is constant. A system in which the accumulators are carried on a separate truck is in use on some Danish and Swedish lines; as regards the cost it is stated that on the German line it is not any greater than for the illumination by gas.

Central Stations.—A recent lecture by Mr. Oscar V. Miller is abstracted in the "Elek. Anz.," Oct. 25. From experience based on 30 stations he obtains the following general data, of use in the original designing of central stations: for every hundred meters of length of street, he finds that one can count on about 30 lamps of 16-cp for the original station and 60 for a station subsequently enlarged and a power consumption of 2 to 10-hp per 1,000 inhabitants. Whether the alternating or continuous current should be used can only be decided for each case separately; incandescent lights will burn equally well with both, and for arc lights the difference is very slight; continuous current lamps are better for streets and open spaces, while the alternating current lamps are better for internal illumination; alternating current motors are as good and in some cases better than continuous current motors; the use of accumulators involves a saving of 15 per cent. in the fuel.

Central Stations in Paris.—"L'Ind. Elec.," publishes periodically very complete statistical and descriptive information regarding the central stations in Paris and France. The greater part of the issue for Oct. 25, is devoted to such information regarding the central stations in Paris brought up to date. It includes a large double page map of Paris and three double page tables.

Central Stations.—An interesting comparative summary of a number of prominent stations in Europe outside of France, is given by Mr. Miron in "L'Ind. Elec.," Oct. 25; similar information is given for each station for comparisons.

Central and Private Stations.—The "Elek. Zeit.," Oct. 25, publishes a paper by Dr. Rasch in reply to the recently made criticism mentioned in the Digest last week. He discusses the relative importance of central stations and separate installations and gives statistics for a number of cities in Germany; he concludes that the gas motor does not take the part in electric lighting that has been claimed; also that under certain circumstances a private installation may be more economical than a connection with a central station, but that this is by no means general and the criticism is therefore unfounded.

Switchboard.—A description by Mr. Mueller of the switchboard used at the Budapest installation is published with very good illustrations in the "Elek. Zeit.," Oct. 25; it will be remembered that this station contains three two-phase alternators of 400-hp, the current from which is transformed at secondary stations into a continuous current, part of which is used for accumulators.

Choking Coils vs. Resistances.—Mr. Rankin Kennedy, in the Lond. 'Elec. Rev.," Oct. 26, announces himself as decidedly averse to the use of alternating currents for public supply; he shows that the advantage of choking coils over resistances, to the consumer, depends entirely on where the choking coil is inserted; if placed on the consumer's side of the meter the choking coil saves nothing more to the consumer than a resistance does, but the supply company gains enormously, as the energy is saved to them; unless it is placed on the supplier's side of the meter and that meter is an alternating energy meter and not a current meter like the Schallenberger, the saving will not be registered in the meter; if a current meter is used a choking coil saves nothing to the consumer no matter where it is placed; the consumer is safe in using a transformer, by which he secures any savings for himself.

Phase Regulation.—In a communication by Mr. Stort to the "Elek. Zeit.," Oct. 25, he states that Prof. Ferraris was the first to indicate the use of phase indicators; in his famous paper published in 1887 to 1888 he stated that if a light cylinder of copper is placed inside of two coils at right angles to each other so that it fills the hollow space almost entirely, and if it has a bifilar suspension, it will form a very sensitive instrument, even with weak currents, for measuring the phase difference; a reference to the original publication is given.

A translation of the article of Mr. Imhoff, abstracted in the Digest, Oct. 13, is published with the illustrations, in the Lond. "Elec. Rev.," Oct. 26.

Disposal of Town and Other Refuse.—A paper by Mr. Deas, read before the Sanitary Institute at Berlin, is reprinted in full with a large number of illustrations, in the Lond. "Elec. Eng.," Oct. 26.

Governing of Steam Engines when Coupled with Dynamos.—A second article by Mr. Addenbrooke is published in the Lond. "Elec.," Oct. 26.

WIRES, WIRING AND CONDUITS.

Wire Gauge—The English journals of Oct. 26 describe and illustrate an ingenious and simple wire gauge consisting essentially of a round disk placed eccentrically in a circular apperture of slightly larger diameter in another disk, thus leaving a crescent-shaped space between them and forming the equivalent of a wire gauge consisting of two straight edges making a small angle with each other; the two similar halves of this crescent-shaped opening, and the two sides of the gauge are taken advantage of by having engraved on them eight different scales which, together with a double scale, gives the equivalent of nine scales each of which gives some information about the wire, such as the size, resistance, weight, current capacity, etc.; except for very important purposes it dispenses with reference to tables.

Submarine Cables of the World.—A supplement of 40 pages to the "Journal Telegraphique," Oct. 25, gives classified, tabulated data regarding all the submarine cables of the world; the tables give the end stations, the date of laying, the number of conductors in each section, the length of cable and wire, the nature of the management and occasionally some remarks; it is doubtless the most complete table of its kind ever published.

Submarine Cable.—The system of S. Thompson for increasing the mutual induction between the lead and its return, is illustrated in "L'Eclairage Elec.," Oct. 13; the two insulated wires are wound with a band of iron, after which they are covered with insulation and an armor; it is said that this increases considerably the rapidity of the signals to be transmitted.

Fuses for Alternating Currents.—The fact that fuse wires blow more frequently for alternating than for continuous currents is thought by the "Elek. Zeit.," Oct. 25, to be due to the fact that screws and other connections are more apt to become loose with alternating than with direct currents.

Stoneware Conduits.—An illustrated description of the Doulton conduit adopted by several of the London companies, is given in the Lond. "Elec. Eng.," Oct. 26; it is a sectional conduit made of stoneware casings containing three ducts.

Electrolysis of Water Mains.—The Lond. "Elec. Eng.," Oct. 26, reprints the report of Mr. Benzenberg at the recent Convention of the American Waterworks Association.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Microphone Induction Coils.—A new method of winding and connecting is illustrated and described in the "Elek. Anz.," Oct. 21; it is claimed that the action of the coil is thereby utilized more completely; with smaller dimensions and lower resistances these coils will have a more powerful action, as both the windings are in the same circuit and assist each other mutually; there will be no perceptible consumption at the microphone contacts, as the extra current in the primary is discharged through the line; it appears to consist of a single coil, a few turns of which form the primary, while all the turns form the secondary.

Pacific Cable.—The Lond. "Elec. Rev.,' Oct. 26, states that according to the "Times," the British Government tried to negotiate with the Hawaiian authorities for the purchase of Neckar Island as a landing place, but a San Francisco despatch states that it was not successful as the reciprocity treaty between the United States and Hawaii prevents the latter from conceding any of its territory to Great Britain.

Telegraphy in Queensland.—A report for 1893 is abstracted briefly in the Lond. "Elec. Rev.," Oct. 26.

Harmonic Call Bells.—In the Lond. "Elec. Rev.," Oct. 26, Mr. Bagnold states that the bell described recently by Mr. Mott in The Electrical World, would not ring and would make only an unpleasant noise; to make it ring one of the pole pieces must be removed; this seems to prove that a bell does not vibrate in two ellipses.

ELECTRO-CHEMISTRY.

Spongy Lead in Primary Batteries.—In an article by Mr. Darrieus in "L'Elec.," Oct. 13, he discusses the use of spongy lead in place of the zinc and gives the results of experiments. In the Daniell cell the E. M. F. is 0.64 volt, but the discharge is remarkably constant for even a very rapid discharge; the internal resistance does not vary very appreciably during the discharge, as the product of the reaction does not form a soluble salt which would change the concentration, and therefore the resistance of the liquids; it possesses the same fault as the zinc form, in that copper deposits on the spongy lead when the battery is not in use, causing a very rapid fall in the E. M. F. A cell made of a plate of lead and another one of spongy lead, both in sulphuric acid, gave an E. M. F. of 0.46 volt, the spongy lead being the negative plate, and therefore the more oxidizable one. Using spongy lead in the bichromate cell, in a porous cup containing sulphuric acid, the E. M. F. was 1.42 volts; the voltage is nearly constant during the discharge, but not as much so as in the Daniell cell. When used in the Bunsen cell the E. M. F. was 1.32 volts and the constancy of the voltage of the discharge was nearly absolute. In conclusion, he states that it is a mistake to say that the negative electrode in a cell must be a soluble electrode, as in none of these is the lead dissolved; such cells are applicable in laboratories where constancy in the discharge is important; such spongy lead plates may be formed by pasting a lead plate with oxide or some salt of lead and reducing with zinc in acidulated water; they may be regenerated by reducing with zinc in the same way.

Lead Dust Accumulator.—The Lond. "Elec. Rev.," Oct. 26, refers briefly to this accumulator made by the Gelnhausen Company; the active mass consists of mechanically prepared lead dust and neutral substances of a porous structure; it is claimed that the large quantity of the neutral, porous substance mixed with the lead prevents the particles of lead peroxide from forming closed strata; it is thought that the oxidation and reduction of the active mass will be effected more completely and rapidly by the penetration and more rapid action of the gases than in the much denser active material of electrodes consisting exclusively of lead compounds.

Chloride Accumulator.—According to the Lond. "Elec. Rev.," Oct. 26, the first mention of chloride of lead and chloride of zinc was made in a patent to Marchenay and that Mr. Payen, although a Frenchman, did not patent his process in France.

MISCELLANEOUS.

Practical Application of Ozone.—An abstract of a paper by Dr. Froelich is published in the "Elek. Zeit.," Oct. 18; it deals with the practical and possible applications, which are briefly as follows: In sterilizing, if the liquid contains oxidizable substances besides the bacilli, the ozone will first oxidize the former, and it can, therefore, be applied to advantage only if the liquid is tolerably free from such substances; the destruction of the bacilli is instantaneous and includes all those which have been experimented with, such as those of cholera, typhus, and in general those causing disease. For ventilation it has been shown that the bacilli in the air and on the walls are only affected in a slight degree, and the application in hospitals is therefore not practical; in the application to the air in theaters, halls, etc., it is stated that the artificially ozonized air is quite different from that in a forest, and it has a decided odor, such that the application in the above cases would hardly be agreeable; effective ventilation, however, can be obtained if the ozone is mixed with volatile oils, giving a pleasant odor. Experiments with the destruction of the phylloxera vastatrix on grapevines have, in general, given unsatisfactory results when the ozone was forced into the earth around the roots, but when applied to the plant 93 per cent. of the phylloxera were destroyed. In the application to the ageing of spirits, results showed that light and acid wines were effected but little, while sweet, heavy wines and cordials were altered very considerably; the best application is a moderate one, but repeated often. Application to tobacco and coffee gave favorable results, especially with the coffee when it contained some beans having a bad odor, and which ordinarily may spoil a whole shipment of coffee, with the application of ozone their effect is totally destroyed; it also increases the taste and odor of the coffee, but diminishes its clearness; favorable results were also obtained with new tobacco, but it can hardly be considered a commercial application. An entirely new application, although not yet practicable commercially, is the production of nitric acid from air; he has succeeded in developing a new process, a description of which is promised. The application to the ageing of wood, particularly for pianos, in 12 to 14 hours, has been in successful use for some years. The oxidization of linseed oil is accomplished in a few days. The application to the bleaching of linen is described at some length and it is claimed that their process has been the only effective one, and that the time required is only one-third as great as that required for bleaching in the sun. The application to starch and its derivatives, which is said to be the most important technical application of ozone, is described at some length; it is especially applicable to the production of pure derivatives of starch from the ordinary quality especially from potato starch.

Electricity in Aeronautics.—In replying to the editorial in the Lond. "Elec. Rev.," abstracted in the Digest, Oct. 27, Mr. Maxim, in the issue of Oct. 12, describes his experiments briefly and states that it is yet to be demonstrated that an electric motor can be built which is as light as his steam engine; he considered the matter thoroughly and found that any form of electric motor was quite out of the question on account of the great weight; if wires were used and if the machine traveled at the rate of 40 miles an hour, a few seconds would suffice to have a large amount of cable in the air; besides, a machine attached to the earth by a cable cannot be considered a flying machine; he has constructed a machine which will lift its own full weight, including a motor and 2,000 pounds besides.

Electric Power in Engineering Works.—A presidential address by Mr. Richardson is published in full in the Lond. "Elec. Eng.," and almost in full in the Lond. "Elec.," Oct. 19. He gives some interesting illustrations of the application of electrical driving machinery in a factory; he considers chiefly the application to existing works as distinguished from new works and discusses the economy that can be expected from substituting for scattered engines supplied from one set of boilers, electric motors supplied with current from a central source; also whether the results justify the expenditure. He considers two factories of about equal driving power, one having an electric installation and the other steam; an illustration of the former is the National Arms factory in Belgium, which is driven entirely by electric motors aggregating 500-hp, and in which the motors drive lines of shafting only, the installation being said to be the most complete of its kind in the world; he describes this in detail, giving data; he then gives a description and tabulated data of an old established marine engine works of about the same power and finds that the consumption of coal would be about 36 tons per day, while for the electric plant it would be 13 tons; besides the economy in coal there will be a reduction in the price of the labor, which, for stoking alone, would be about one-half; a table gives the loss in per cent. for driving the shafting, belts, pulleys, etc., an average for which is about 50 per cent.; in one case cited this loss was 75.6 per cent. He mentions also an installation at the Bedson Wire Company, in which all the machines are driven separately by electric motors and which is said to be the most perfect and most complete of this kind in that country. From his comparison he concludes that the saving gained by the substitution of electrical driving in an old established works would be considerable. In an editorial mentioned in the Lond. "Elec." it is thought that the use of motors for driving each of various shops would probably be the most suited for existing shops, while the more thorough system of driving each tool with a separate motor, might be more economical to adopt when an entirely new factory is to be erected; each particular case, however, must be judged according to its individual conditions.

Electricity as a Motive Power.—The Lond. "Elec. Eng.," Oct. 26, begins a reprint of the discusssion of the paper by Mr. Selby-Bigge (see Digest, Sept. 15). In this discussion, Mr. Charlton describes at some length the plant at Pitkin, Colorado, and that at Bodie, California. Mr. Richards discusses some remarks regarding engines.

Self-regulating Pump.—A pump driven by an electric motor operated by a device actuated by a float in the reservoir tank, is described and illustrated in the "Elek. Anz.," Oct. 25.

Submarine Detector.—Mr. Duncan, in the Lond. "Elec. Rev.," Oct. 26, states that the report of the successful use of an electric submarine detector in the search for the sunken Russian ironclad, as published in the English journals and in The Electrical World, Nov. 3, has since proved to be unfounded; the apparatus was out of order and gave signals without due cause; the divers did not descend and did not find the vessel; nothing was found and the experiments have been abandoned to be continued next spring, using a "magnetic inclinator."

Current Indicator.—A simple device is described and illustated in "L'Elec.," Oct. 20; it is for use chiefly in arc lighting circuits to show where the current is flowing; it consists of a coil with a vertical movable core, which operates a red or white signal, according to its position in the coil.

Automatic Steering Compass.—An Academy paper by Mr. Bersier describing his system, mentioned in the Digest, June 2 and Oct. 6, is reprinted in "L'Ind. Elec.," Oct. 25, and "L'Elec.," Oct. 20.

Lightning.—Some recent observations of Prof. Zenger, with three remarkable lightning bolts and their connection with water spouts, are published in "L'Eclairage Elec.," Oct. 13.

Educational.—London "Electricity," Oct. 26, continues the series of the new technical examinations for the British Telegraph department; also notes and examples in electro-technology for the City and Guilds Institute. As these are being continued through successive issues they will not be mentioned again in the Digest The Lond. "Elec. Eng.," Oct. 26, continues the publication of the elementary lectures at the City and Guilds of London Institute. As these lectures form a serial they will not be noticed again in the Digest.

Antwerp Exhibition.—A descriptive article of some length by Mr. Barbier, a considerable portion of which is devoted to the electrical exhibits, is published in the "Memoirs de la Societe des Ingenieurs Civils" for August.

New Books.

MAGNETISCHE KREISE, DEREN THEORIE UND ANWENDUNG. von Dr. H. du Bois (Magnetic Circuits, Their Theory and Application, by Dr. H. du Bois). Berlin: Julius Springer. 1894. 382 pages, 94 illustrations. Price, 10 marks.

This work, which has recently been issued, may be said to be the first large and complete work of a high order devoted exclusively to the subject of magnetism. The name of the author alone would vouch for the fact that the work was of a very high character. As the preface is dated February, 1894, the book is quite up to date, except perhaps in so far that the names of the magnetic units, which are now being introduced in this country, are not used, the consequence of which is that the units are designated merely as C. G. S. units or still more generally, units, leaving it to the context to show which particular unit is meant; it is greatly to be regretted that in such an important treatise the names for the magnetic units are not used, as they might at least have been inserted in parenthesis. The first part is devoted to theory and is similar in its style and character to that in Maxwell's well-known treatise; it is of course highly mathematical in character but will form a very valuable work of reference to the mathematical treatment of the subject of magnetism.

The second part treats of the applications and is of a much more practical character, many parts being within the reach of the educated engineer and constructor. The subject of the magnetic law is, strange to say, included in the second part and not in the first or theoretical part. In this connection an interesting table of analogies is given of similar laws in filtration, diffusion, heat conduction, dielectric polarization, electric conduction and ferro-magnetic induction. A separate chapter is devoted to a practical discussion of the magnetic circuit in dynamos and motors and another one is devoted to transformers. In the chapter on electromagnets and transformers is included a complete description of the author's recent interesting researches with the most powerful fields yet produced.

Although the work is of value chiefly to the more advanced student, and is perhaps invaluable to him, there is much in it that can be appreciated by the practical engineer and constructor. The general appearance of the book is neat and the illustrations are especially clear and well selected, most, if not all of them, it appears, having been made specially for this work.

A Southern Electrical Transmission Plant.

A contract has recently been awarded by the Pelzer Mfg. Company, Pelzer, S. C., for three 1,000-hp 3,500-volt three-phased generators. The generators will be direct connected with three horizontal Victor turbines making 167 revolutions per minute. The dam of the plant is now being built and will be 120 feet wide, giving a fall of 30 feet. The generators are to be used in transmitting power from this fall to a factory, which is now being built near the present factory of the Pelzer Company, a distance of 2½ miles.

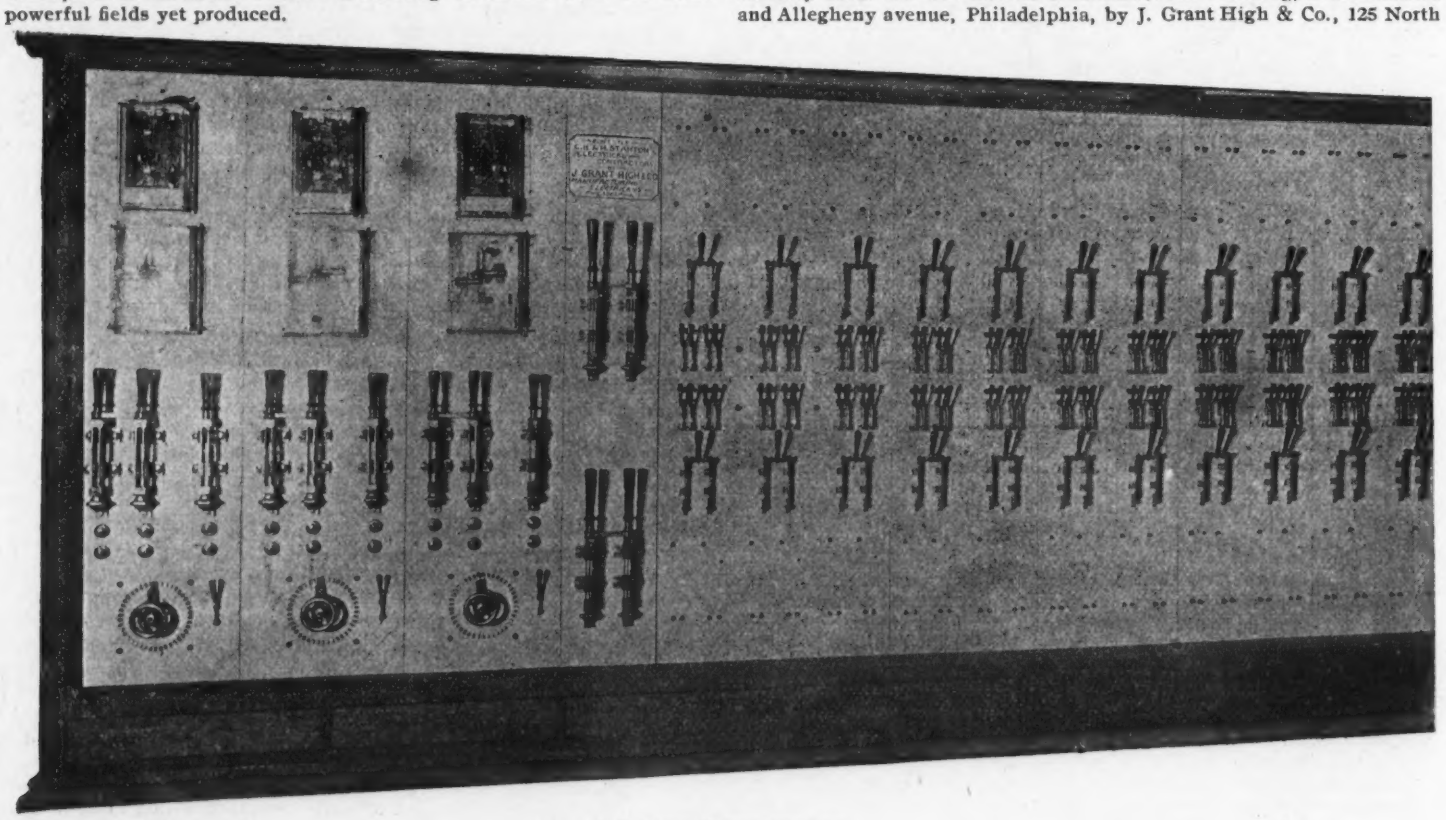
Step-down transformers will lower the voltage to 220 volts and induction motors of the type used in the Columbia Mills, Columbia, S. C., whose electrical plant was recently described in our columns, will be used, ranging in size from 20-hp to 110-hp. One 400-hp synchronous motor will take the place of the Harris-Corliss engine now running the No. 3 Mill, to be fed electrically from the line without the intervention of transformers. The capacity of the present mills is 52,000 spindles, and the new mill being built, 484 feet long and 128 feet wide, will have a capacity of 50,000 spindles.

The reasons for the Pelzer Company adopting electrical transmission were that the present mills are connected with a spur from the railroad, and have all the conveniences of a town. Near the present mills there is a beautiful site for the new mill, and taking into consideration everything—the excessive cost of a mill building at the waterfall on account of excavations, proximity of the railroad spur, the town conveniences, the ability to have the mill practically under one management and in proximity to the mill offices—the company decided to adopt electric transmission.

The installation of this plant is a matter of importance for the South, as it will accelerate the utilization of her numberless water powers, and much credit is due to Messrs. Lockwood, Greene & Co., who are the mill engineers, and to Prof. A. F. McKissick, of the Alabama Polytechnic Institute, Auburn, Ala., the consulting electrical engineer, for their recommendations leading to the adoption of electricity. The contract for the electrical machinery was awarded to the General Electric Company.

A Large Switchboard.

The accompanying illustration shows part of a large switchboard recently built for the Warden Tenement Mill Building, at Nineteenth and Allegheny avenue, Philadelphia, by J. Grant High & Co., 125 North Third street, Philadelphia. This board is made up of slabs of white Italian marble 8′ high 1½″ thick and 30″ long; the slabs are firmly held together and supported from the floor by wrought iron shapes. The back ends and top of the switchboard are enclosed in a cupboard made of hard wood finished in oil and rubbed down. The back ends consist of doors with panels throughout; the doors are hung on brass butts and furnished with brass Yale locks, so that all parts of the board may be rendered visible and accessible to the engineer at any time for the purpose of making adjustments and repairs. On the lighting end of the board, of which only a part is shown in the cut, are mounted 34 150-ampere D. P. switches and 146 auxiliary switches for fusing with 2 1,500-ampere switches for feeders. On the dynamo end of the board are 3 Westinghouse ammeters and 3 Westinghouse volt-meters. On the bottom of the dynamo board are mounted 3 rheostats of the Carpenter style with flush face, and in the centre of the board are 6 700-ampere switches and 3 S. P. and 3 D. P. and 3 small 30-ampere S. P. switches. On the back of the door are mounted 3 sets of copper bus bars and connections, weighing in all nearly 2,500 lbs.



A Large Switchboard.

The Keystone Ammeter.

The accompanying illustration shows an ammeter, made by the Keystone Electrical Instrument Company, of Philadelphia, for which The George L. Colgate Company, of this city, is sole agent.

These instruments, which are known as "Type K," contain no permanent magnets or springs and are therefore not liable to deterioration. All moving parts are mounted in jewel bearings and the case is thoroughly dust-proof. The voltmeters are of high resistance, thus requiring a minimum amount of current and may be left in circuit continuously without affecting the readings. There is also said to be an entire absence of magnetic lag and no heating error. All moving parts are magnetically shielded so that the effect of external magnetism is not appreciable.

The scales in the instruments are large, with generous divisions and so arranged that within the limits of the scale, readings may be obtained to about 1-5 of the division points marked.

The instruments are very easy to set in position on switchboards, the only requirement being that they shall be plumb. This is easily accomplished by seeing that the needle points to zero when no current is

TYPE "K" KEYSTONE AMMETER.

flowing through the instruments. The holes in the flange of the case to receive the screws which fasten the instrument to the board, are slotted to allow the adjustment to be made after the instrument has been placed, or to adjust it in case the switchboard should get out of level.

Each instrument after calibration, is sealed in such a manner that it is impossible to inspect the moving parts without breaking the seal. A calibration card accompanies each instrument shipped, giving the number of instrument, certifying to the correctness of calibration at a given temperature and, in the case of a voltmeter, the resistance of the coil is also stated.

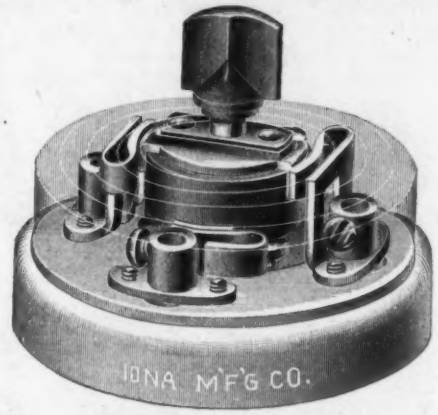
Iona Specialties.

The Iona Manufacturing Company, Boston, of which J. Jones & Son, 67 Cortlandt street, New York, are agents, have recently brought out several interesting specialties, several of which we illustrate herewith. The new Iona snap switch consists of the necessary number of contact springs somewhat in form like cotter pins, but shorter, one end being stationary, and the other loose, the latter making the connecting points. This spring is punched out, into a long strip with a piece attached to one side and end, which finally forms the base of the screw post, upon which the post is mounted, and also the means of attaching the whole to the base. The spring made in this form is strong, also elastic, and makes a good, firm contact point.

The operating mechanism consists of a ratchet, permanently attached to the base, a round disc, having a shaft hole off center, with a projecting finger which stands against the ratchet teeth, a shaft carrying a small eccentric disc, fitted into the shaft hole in a large round disc carrying the projecting finger, above which is the connecting bar, held down by a spiral spring, and in position by a second projecting finger of the round disc, coming up through a hole in its surface. The spiral spring mentioned is attached permanently to the top of the shaft, its loose and lower end lying normally against a third finger on the round disc, and exerting sufficient pressure to hold the lower projecting finger of the round disc firmly against one of the ratchet teeth. In operating, the small eccentric disc throws the large round disc outward, until the lower projecting finger is released from the ratchet tooth which it has been resting against, when the spring, that in the meantime has been creating a greater pressure on the round disc through the turning of the handle, tending to wind it up, throws the contact bar forward and makes or breaks circuit, as the case may be.

The movement is quick and positive, the break is long and the contact large. All the parts are strong and made for wear. The spring is of a special steel wire. The desire has been to overcome in it the faults to be found with most of the switches now on the market. Another good point is that the position of the handles shows whether current is on or off.

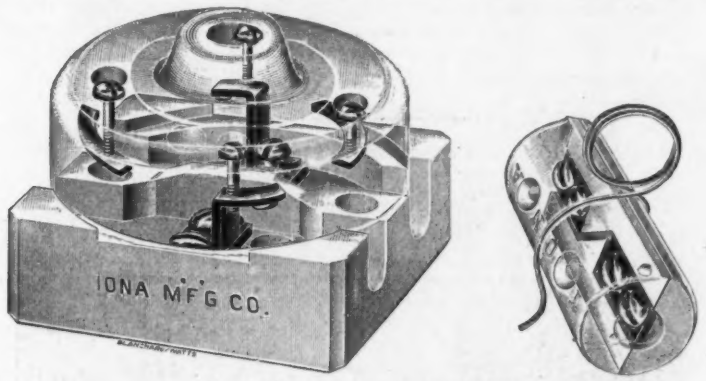
In connection with these switches, the Iona Company manufactures a porcelain block for setting them on, with abundant room for leading in



DOUBLE POLE SWITCH.

the wires in a neat manner, especially in connection with moulding cleat work.

In porcelain goods among the many new specialties recently brought out is a combination cut-out, the cover of which is securely fastened by one turn of the screw-driver, and with the cap will take in cord of



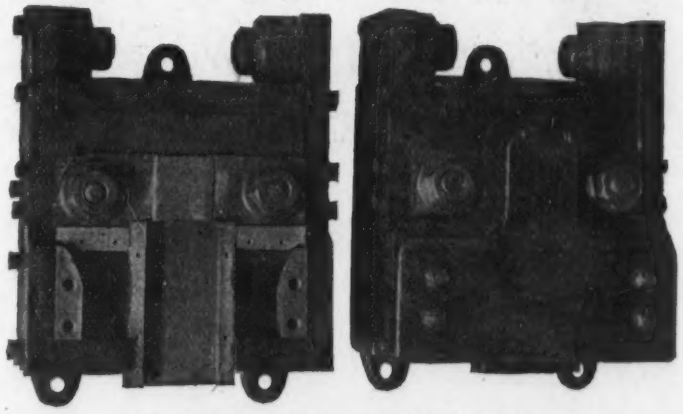
COMBINATION AND "BUG" CUT-OUTS.

double the ordinary size used. The cut-out can be used for cleat, concealed or moulded work, though specially intended for the latter.

The little porcelain covered bug cut-out shown in the accompanying cut is also meeting with much favor among the fixture men and others requiring a single pole cut-out to go in a small space and meet the requirements of the underwriters.

Magnetic Blow-out Fuses.

An interesting experiment was recently made at the Kent avenue station of the Brooklyn City Railroad Co. to test the efficiency of the magetic blow-out principle in the fuse carriers which form part of the

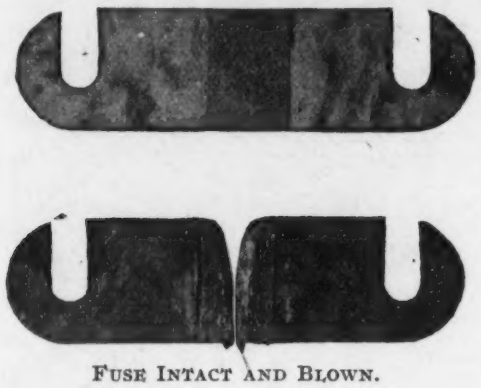


MAGNETIC BLOW-OUT FUSE CARRIERS.

General Electric Company's generator equipments. Previous to the test there had been, on the part of the railroad company, no little skepticism as to the value of the magnetic blow-out principle, and the test was made with the view primarily of proving the correctness of the claims of the manufacturing company, that the apparatus would cope with almost any demand made upon it.

The test was made on the company's dock behind the station, under

the supervision of Mr. Walter A. Pearson, Superintendent of the station. Six water rheostats of large capacity were connected into the circuit in series in order to regulate the load and the conductors were brought directly from two of the four 1,500-kw. multipolar generators. The fuse blew at 4,400 amperes at 550 volts, an equivalent in horse power of 3,243 hp. The result of the test was a complete demonstration of the efficiency of the magnetic blow-out on a very powerful and destructive arc. The cut shows the blown fuse and one of similar capacity intact. It will be seen that the action of the magnetic blow-out must have been



Fuse Intact and Blown.

.nstantaneous, and, perhaps, the most remarkable feature is the small amount of metal blown.

The magnetic blow-out principle is a special characteristic of all apparatus manufactured by the General Electric Company which has to deal with possible arcs. It is successfully embodied in the well-known K-car controller as well as in the lightning arresters, fuse-boxes, etc. It is claimed to be the only known method of preventing destructive arcing.

A Cincinnati Electrical Enterprise.

Cincinnati has long been recognized as one of the most favored cities in the Union for manufacturing facilities. In geographical location,

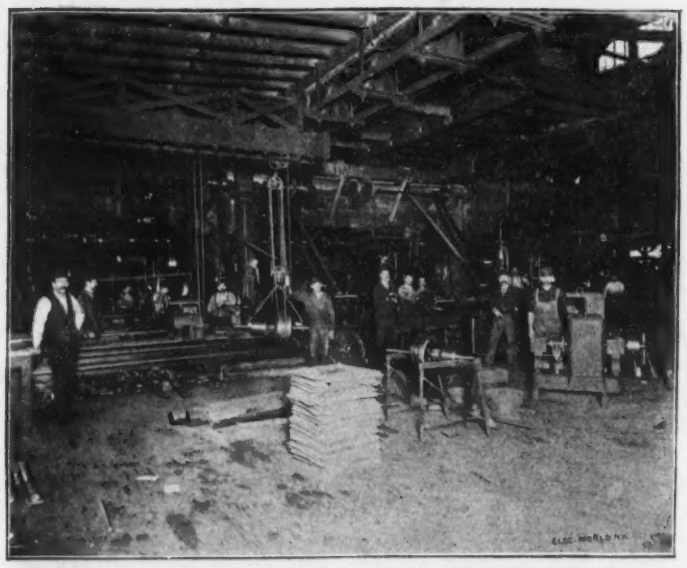


Fig. 1.—Main Floor.

it is the center of a wide section of country, while the cost of obtaining coal and iron is enormously low as compared with many other localities. These facts have led to the establishment of scores of manufacturing plants, particularly in the line of machinery, engines, etc. Now it bids fair to become a great electrical center.

One of the latest candidates in this field of work is the Triumph Electric Company, whose headquarters and factory are at South Second street. The outside appearance of the building is characteristic of Cincinnati factories, very unostentatious, but once inside, the visitor is surprised to find one of the best equipped electrical factories in the country. The machines are of the finest grade and of every description necessary to the production of electrical apparatus. Fig. 1 gives a good view of the main floor. This room is about 200 feet long and 350 deep, one-half being devoted to the assembling and finishing of dynamos and motors, while the remainder is given to the machinery. The illustration shows quite a number of workmen busy with their various occupations, but this gives no idea of the force in the employ of the company. Fig. 2 shows the winding department on the second floor, where most of the repair work is done. This feature of the Triumph Company's work is one of especial importance, it having contracts with some of the largest electrical enterprises in Cincinnati, one being the Cincinnati Edison Company.

The product of this factory, having been introduced in many sections of the country, has many features of interest. The dynamo is known as "The Triumph," and is especially designed to meet the demand for a distinctly low-priced dynamo. That there is such a demand no one questions, and "The Triumph" aims to fill the bill, being at the same time within all the electrical and mechanical requirements. Its particular feature is its magnetically enclosed armature. The advantages claimed for this type are great strength, short magnetic circuit, no external magnetism, brushes set without lead and great efficiency.

J. C. Hobart, who is secretary and superintendent of the company, and practically the one who called it into existence, is a very young man but one destined to make his mark. Graduating from the Massachusetts Institute of Technology, as a mechanical engineer, he for a long

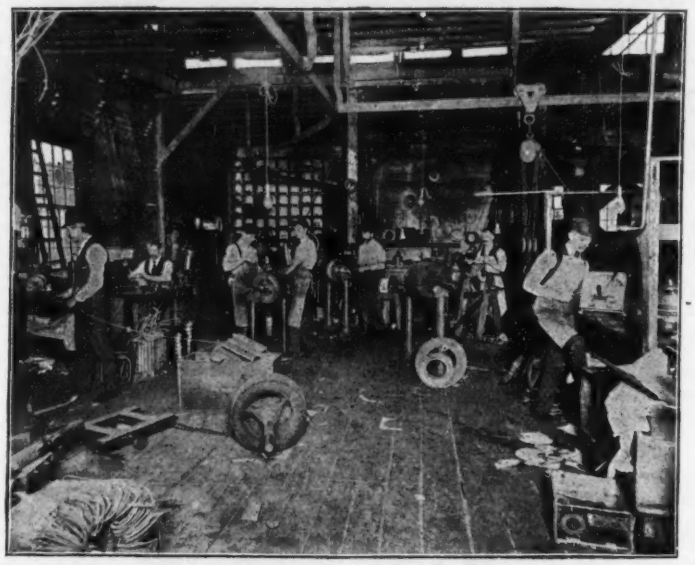
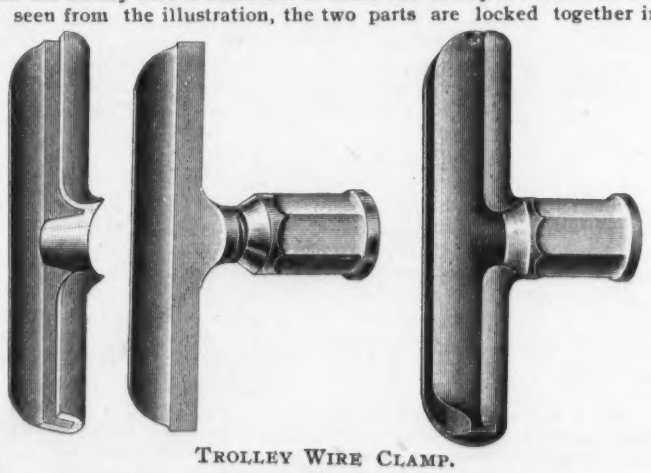


Fig. 2.—Winding Department.

time devoted himelf especially to mechanical engineering. When the Triumph Compound Company, was started, Mr. Hobart became the ruling spirit of the enterprise and was still connected with it when he perfected the electrical apparatus now manufactured under his supervision. In this latter work he has many advantages over purely electrical engineers, because he has a most thorough practical knowledge of the mechanical requirements of electrical apparatus, and to his knowledge in this respect is in a large measure due the success of the "Triumph" dynamo.

New Trolley Wire Clamp.

A new trolley wire clamp, illustrated herewith, has recently been developed by the Central Electric Company, 173 Adams street, Chicago, and presents a neat and compact appearance, without in any way detracting from the necessary strength. No strain that is brought to bear upon the trolley wire is sufficient to cause this clamp to release its hold. As seen from the illustration, the two parts are locked together in a



Trolley Wire Clamp.

manner that makes it simply impossible for it to become displaced after being hung. Of course no soldering is necessary. No obstruction is offered to the passage of the trolley, it having a perfectly level track to run on, and consequently there is no destructive or wasteful sparking. These clamps are made to fit either a ⅜ or 7-16 in. stud, and are furnished in bronze or malleable iron.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET

NEW YORK, Nov. 10, 18949.

GENERAL ELECTRIC did not fail to take an active part in the boom noted towards the end of the week in the active stock list. As has been related, there has for the past few weeks been a very large short interest not only in this but also in other active stocks, and the tremendous bull argument afforded by the election returns has had the effect of effectually scaring the bear crowd into covering their short contracts, to the great appreciation of quotations. General Electric bulls have had additional help afforded them in their campaigning against the bear enemy in the favorable news relative to large contracts and increasing business made public recently. One of these reports had to do with a contract for equipping the entire Yerkes street railway system in Chicago. Another to a second announcement that President Coffin is one of the backers of a scheme to consolidate four electrical companies at Toledo, two of which are electric street railway companies, and the General Electric Company will hereafter furnish all supplies for the consolidation, which is capitalized at nearly $5,000,000. A United Press dispatch brings this news from Schenectady: "The managers of the General Electric Company have advertised for plans and specifications for two new buildings to add to their extensive plant in this city. When the bids have been examined and accepted the contract will be let at once for the erection of the structures with all reasonable expedition. These new buildings will be a storehouse, 350x52 feet, and a laboratory. Their construction not only adds to the capacity and facilities of the works, but it shows especially that the Edison General Electric plant is here to stay. The recent determination to send some motor work to the shops at Lynn is in accordance with the purpose not to overload the works here, but to have an annex, as it were, for extra special work whenever the latter too much taxes the capacity of the main shops and force engaged in this city." From this it may be inferred that the General Electric Company is busy these days. In fact, an official is quoted as saying that it now has 85 per cent. of the business in electrical supplies, and that the company's prospects are steadily improving. Notwithstanding keen competition, the company is more than holding its own, and is making a profit on its sales—a profit admittedly small, but sufficient, according to official statements, to not only pay the dividend on the preferred, but even leaving something over for the common stock. Of course, no payments of this character can be ordered for some time, as no action has yet been taken regarding a reduction of the capitalization to make good the impairment, and nothing will be done in this direction for some time. In the meantime the company will pay off as quickly as possible the outstanding guaranties and endorsements, which at present aggregate but $135,000. With its other surplus funds the company will continue to retire its debenture bonds. General Electric has now cash on hand amounting to $770,000, including, however, $250,000 for coupons due next December. Altogether there is a more hopeful feeling among the managers of the company, as they feel certain that General Electric's future is now assured.

WESTINGHOUSE ELECTRIC issues have been too quiet to reflect by increasing quotations the prevailing improved business situation. It may be, too, that new litigation into which the Westinghouse Company was plunged during the past week may have interfered with any advance. One of these suits has to do with an injunction brought by the United States Electric Light Company—this is the concern which absorbed the old Weston Company, extended the plant, and was in turn merged with the Westinghouse Company—preventing the Westinghouse people from moving machinery out of the Newark shop. Another suit which came up this week for a hearing before the United States Circuit Court in Boston has to do with the claim of William Stanley, Jr., that certain patents secured from him by the Westinghouse Company were procured by fraud. The company's officials refuse to discuss the case otherwise than to say that they do not anticipate any but a favorable outcome of the litigation. The wide currency given to the matter may, however, have stopped speculation in the company's stock issues for the time being, but the officials seem not to be concerned about this.

THE AMERICAN DISTRICT TELEGRAPH COMPANY'S board of directors, as intimated last week, met, but postponed action on the dividend now due, "owing," it was stated, "to the lack of a quorum". This practically amounts to the passing of the dividend at the present moment; but this has been discounted in the speculation, and quotations fail to show much change.

WESTERN UNION TELEGRAPH has been weak at odd times on long selling of stock. The adoption of a constitutional amendment in New York State for bidding race track betting, among other forms of gambling, is expected to seriously curtail the revenues of the Western Union Company. This occasioned some selling out of investment holdings, which was accelerated by professional sales of the stock on the reports of the serious crippling by storms of the company's New England lines. All in all, however, the stock has held pretty steady during the past week.

THE STREET RAILWAY & ILLUMINATING PROPERTIES trustees have purchased more preferred stock, cancelling 764 shares at an average price of 100.75, a good advance over the last price paid. All in all, a total of 17,107 shares has been retired to date.

AMERICAN BELL TELEPHONE continues weakish. The storms throughout the Eastern section of the country did large damage to its wires, the long distance telephone service being chiefly demoralized. The loss to the company will be heavy, and is aggravated by the interference with business. This loss of revenue and the likelihood that 10,000 new shares will come upon the stock market as a result of the special stockholders' meeting on the 15th inst., have been the chief factors causing the selling of long stock noticeable this week.

ERIE TELEPHONE STOCK fails to display much life on the New York Stock Exchange. A report for the quarter ended September 30, made public this week, shows that the Erie Company received in dividends on its holdings of the stocks of the three sub companies $61,587, or $2,227 more than in 1893. It paid out in dividends $48,000, the same as last year, so that it has a surplus of $13,587, or a gain of $1,957. For the nine months ended September 30 there is a surplus, after paying dividends, of $35,080, a gain of $2,740 over the same period in 1893.

THE STANDARD UNDERGROUND CABLE COMPANY, of Pittsburg, now that the claim against the United Electric Light & Power Company, of New York, has been paid in cash, bonds and stocks to an amount materially in excess of the original indebtedness, is in splendid financial shape. Those well posted concerning the company's affairs state that it will increase its dividend rate in January. It now pays 6 per cent. per annum, or 1½ per cent. quarterly.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	100½	101⅛
" " " Brooklyn	100	110	112
" " " Boston	100	120	128
Chicago Edison Company	100	120	130
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	12	15
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2¾	2¾
General Electric	100	37⅜	38
General Electric, pref	100	65	70
Interior Conduit & Ins. Co.	100	20	30
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	35	36
" " pref	50	52	53

BONDS.

Edison Electric Ill., New York	1,000	107¾	107¾
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	90	91

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	197	198
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
Central & South American Telegraph	100	101⅛	105
Commercial Cables	100	125	145
Erie Telephone	100	52	54
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
*New England Telephone	100	67	69
Postal Telegraph-Cable	100	54	60
Western Union Telegraph	100	89	89¼

* Ex-div.

NEW INCORPORATIONS.

THE COALPORT-IRVONA LIGHT, HEAT & POWER COMPANY, capital stock $10,000, has been incorporated by R. A. Holden and others.

THE RIVER TELEPHONE LINE, Tomahawk, Wis., capital stock $2,000, has been incorporated by W. H. Bradley, John Landers and A. H. Woodworth.

THE LAKE GEORGE IMPROVEMENT COMPANY, Lake George, N. Y., capital stock $1,000, has been incorporated to operate a telephone line bordering on Lake George.

THE SALINA TELEPHONE COMPANY, Salina, Kan., capital stock $10,000, has been formed to construct and operate a line of telephones in Salina and throughout the county.

THE WILDER-SLOSS ELECTRIC HOTEL CALL COMPANY, Chicago, Ill., capital stock $250,000, has been incorporated by Louis Stein, Augustus Binswonger and Edward R. Wilder.

THE UNION TELEPHONE COMPANY, Parkersburg, W. Va., capital stock $150,000, has been formed by C. H. Shattuck, E. M. Gilkeson, Romney; J. B. Finley, Parsons, and F. B. Sherrick, Marietta.

THE DAYTON LONG DISTANCE TELEPHONE COMPANY, Dayton, O., has been incorporated by J. C. Patterson, J. P. Breene, Gov. J. B. Thomas, Prof. E. T. Brewster, W. H. Shank, W. M. Whitemore and James E. Cronin.

THE PEOPLE'S ELECTRIC COMPANY, Valparaiso, Ind., capital stock $30,000, has been formed to maintain a light, heat and power plant, etc. The interested parties are George M. Willis, Otis E. Turner and James A. Cummins.

THE CLEVELAND & ELYRIA ELECTRIC RAILROAD COMPANY, Columbus, O., capital stock $200,000, has been incorporated by F. T. Pomeroy M. A. Sprague, A. W. Bishop, C. W. D. Miller, Leon M. Boe, Will Christey and A. H. Pomeroy.

THE FOREST CITY ELECTRIC LIGHT AND POWER COMPANY, Forest City, Ia., capital stock $25,000, has been incorporated to operate an electric light and power plant. M. Barton, C. H. Kellogg and J. P. Thompson, Forest City, are interested.

THE UNITED TRACTION COMPANY, Pottsville, Pa., capital stock $10,000, has been incorporated by Charles H. Barritt, Wayne; Wm. A. Barritt, Jr., St. Davids; and John F. Finney, Pottsville, Pa., for supplying motive power to passenger railways, etc.

THE CANTON MUTUAL TELEPHONE COMPANY, Canton, O., capital stock $10,000, has been incorporated by F. D. McKelvey, Joseph A. Linville, B. N. Winings, H. H. McKelvey and George McKelvey, for the purpose of carrying on a telephone business.

THE TRADERS' ANNEX COMPANY, Clarksburg, W.Va., maximum capital stock $1,000,000, has been formed to erect and own buildings, etc., and to construct electric plants, street railways, etc. T. M. Jackson, D. R. Morgan and W. B. Maxwell, Clarksburg, W. Va., are interested.

THE AMERICAN IRON CAR COMPANY, New York, minimum capital stock $5,000, has been incorporated to manufacture and construct passenger, freight, and electric railway cars, etc. The promoters are Carroll Sprigg, Q. A. Gates, Henry Briderman and E. L. Pierson, all of New York City.

THE NORMANDY GOLD MINE, Amador City, Cal., maximum capital stock $100,000, has been formed to manufacture and mine, lease, etc., and to operate water works, electric plants, tramways, etc. Stephen H. Emmens, Chas. A. Week, L. G. Haskin, all of Amador City, are the interested parties.

THE BELDING ELECTRIC ALARM MAIL BOX COMPANY, Chicago, Ill., capital stock $25,000, has been formed to manufacture and sell the electric alarm mail box patented by E. C. T. Belding, and improvements thereon. E. C. T. Belding, T. W. Saunders and C. Stuart Beattie, are the promoters.

THE MOTHER LODE POWER COMPANY, San Francisco, Cal., capital stock $800,000, has been formed to generate and deal in electricity for light, heat and power; compressed air, steam; to own water works, etc., deal in mines, etc. The promoters are J. F. Parks, Jackson; Jackson Dennis, Sutter Creek, and Chas. D. Pierce, Oakland, Cal.

THE DELAWARE AND SCHUYLKILL TRACTION COMPANY, Doylestown, Pa., capital stock $50,000, has been formed to construct and operate motors, cables or other machinery for supplying motive power to passenger railways. Wm. Jenks Fell, Faulkland, Del.; Robt. G. Fulton and Samuel A. Hamilton, Philadelphia, Pa., are the promoters.

THE MONARCH GAS ENGINE MANUFACTURING COMPANY, San Francisco, Cal., capital stock $20,000, has been formed to manufacture and deal in gas, gasoline, electric machinery, steam engines and accessories, and to operate a general machine shop. J. A. Frost, Oakland, W. S. Scott and S. W. Powell, San Francisco, Cal., are the promoters.

McKEES ROCKS, PA.—An ordinance granting rights of way and other privileges to the Phoenix Electric Light Company has been passed by the Borough Council and the company will at once go ahead with the building of a plant that will have a capacity for not only lighting the streets but for the purpose of supplying private consumers. The incorporators are R. L. Townley, W. S. McLain, Jr., H. C. Johnson and J. E. Heinzman.

Special Correspondence.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, November 10, 1894.

IN THE NOTE last week of the New England agency of the Buckeye Engine Company, in referring to its large plant at the Hadley Company, Holyoke, Mass., the triple expansion engine in use at their plant should have been stated as of 1,000-hp, instead of 100.

MR. E. W. HOWARD, formerly connected with the Westinghouse Electric Company at Pittsburg, has purchased the electrical department of the H. C. Fish Machine Company, of Worcester, Mass. It is the intention of Mr Howard to manufacture larger types of dynamos and motors than has been the custom of the company to manufacture, constructing both four-pole and bi-pole machines.

MR. CHARLES G. CHASE, president of the Mason Regulator Company, of Boston, and who has occupied a prominent position, business-wise and socially, in that city for nearly forty years, died suddenly last Thursday, November 8, on his way from his office to his home in Brookline. Mr. Chase was highly esteemed by all who had the pleasure of his acquaintance. In extending our sympathies to Mr. Walter G. Chase, his son, treasurer of the Mason Regulator Company, we feel confident we are voicing also for the electrical fraternity generally, in which he has a wide acquaintance.

CAPTAIN BROPHY, our old and esteemed friend, who has been both a chief of a fire department and an insurance inspector, has been interviewed by the Boston Herald. Boston, justly or unjustly (the latter as it seems to us), has obtained a popular reputation for having more fires than she ought, and bigger ones, and the papers that delight in displayed headlines generally have it "It was thought" to have been caused by an electric light wire. Captain Brophy is in favor of the plan of extinguishing these fires by utilizing the inexhaustible supply of salt water at the very doors of Boston, in the absence of any proper and sufficient gravity system. Large and powerful pumping engines could then furnish high pressure to any part of the city, and until the Atlantic dries up there would be no fear of shortness of supply

SEVERE TOUCH OF WINTER visited Boston on the 5th and 6th insts., before its time. Rain, followed by heavy, wet, clinging snow and low temperature, caused much trouble and inconvenience with overhead wires, and the advocates of an underground system were furnished with a fresh repetition of the argument. Mr. Commissioner Murphy and his staff are hard at work in the direction of getting the first section complete within the prescribed time. The conduits themselves are practically completed, and the larger portion of the work now remaining to be done is the drawing in of the conductors and arranging for the distribution to stores, hotels, residences, etc, from the underground system, which will be effected from the man-holes for the present in all probability. The masses of congealed rain and snow on the wires presented a beautiful sight to the eye of the beholder, but to an electric light or railroad man the beauty was all in his eye, for he knew it meant trouble and a good many hours of hard work

MR. SAMUEL G. STINESS, superintendent of the Pawtucket (R. I.) Gas & Electric Company, whose unfortunate and horrible death occurred last Monday, November 5, at the railroad crossing in that city by being crushed under a train of cars, was one of Pawtucket's most prominent citizens, prominent in both the gas and electrical industries, having been for over thirty years identified with the former and one of the earliest among gas managers to advocate a recognition and affiliation with the latter. He occupied deserved conspicuousness in the New England Gas Association, and was one of the founders of the New England Guild of Gas Managers and the American Gas Light Association. He was prominent in Masonry, and in the business and social walks of life had hosts of friends who will deeply regret his death. His funeral occurred Thursday, November 8, and was largely attended, quite a number of the electrical fraternity from Boston being in attendance. Mr. Stiness left a widow and two sons, both prominent young men.

Canadian Notes.

Ottawa, Nov. 8, 1894.

TORONTO.—The gross earnings of the Street Railway Company for the ten months of 1894 amounted to $803,377.

TORONTO.—The largest engine ever manufactured in Canada for generating electricity was put in motion this week at the power-house of the Toronto Railway Company. It cost $50,000, and is of 1,200 horse power.

TORONTO, ONT.—Two applications have been received by the York Township Council from parties wishing to supply electric light, heat and power within York Township. One was from John W. Moyes, the other was from F. J. Dunbar.

NIAGARA FALLS. Ex-Mayor Manning, R. F. Segsworth, William Kyle and other Toronto men are asking a bonus of $75,000 from the Council at Niagara Falls, Ont., to build an electric railway from the Falls to Drummondville and Queenstown.

OTTAWA, ONT.—There are now in process of incubation in the Ottawa district three electric railway schemes of considerable importance. These are, first, the proposal to connect Ottawa and Brookville by electric road, the Hull and Aylmer scheme, and the Buckingham project.

BROCKVILLE, ONT.—The impending rate war between the Bell Telephone Company, and the Dundas Telephone Company, in Dundas County will likely be called off. It is said that a deal is being arranged whereby the plant of the new company will be taken over by the Bell Company.

ST. CATHERINES, ONT.—The Point Abino Street Railway Company is applying for a charter to construct a street railway in the municipalities of Bertie, Humberstone and Wainfleet, and the villages of Fort Erie and Port Colborne, in the County of Welland, the amount of capital stock of the company to be $100,000.

ST. CATHERINE'S.—Notice is given that application will be made by the Municipal Corporation of the City of St. Catherine's and the St. Catherine's and Niagara Central Railway Company to the Legislative Assembly of Ontario, next session for an act to carry into effect certain proposed arrangements between the petitioners.

OTTAWA, ONT.—The Bell Telephone Company has taken possession of its new buildings. The cables enter the basement from the underground ducts, and embrace 2,800 wires, carrying nearly 1,100 subscribers. The capacity of these underground ducts is 7,200 wires. The length of duct now laid is 47,811 feet, while there are 1,025 miles of wire now in use in the city.

NIAGARA FALLS, ONT.—Notice is given that application will be made at the next session of the legislature of Ontario for an act to incorporate the Toronto, Hamilton & Niagara Falls Electric Railway Company, with power to construct an electric railway from Toronto to Hamilton, thence to the Niagara river at or near Niagara Falls; and also a branch line from the village of Grimsby to Smithville and Dunville.

MONTREAL.—A taxpayer in this city asks the following questions of the City Council: "I see that a contract has just been given by the city of Toronto for the lighting of the city at $72.82½ per light. Is it true that the city of Montreal has been paying $130 for a similar service? If so, why? Say 1,000 lights in Montreal cost $130 each, $130,000; in Toronto, 1,000 lamps at $72.82½, $72,825; annual loss, $57,175; annual loss to taxpayers for ten years, $521,750."

QUEBEC.—Hon. P. L. Pelletier, Hon. Phillippe Landry, J. J. Fremont, M. P.; P. B. Dumoulin, banker; Barnard Leonard, John U. Gregory and Ernest Pacaud, are applying to the Legislature to be incorporated under the name of the Quebec City and District Electric Railway Company, with power to build and run electric railways in the city of Quebec, and also in the counties of Quebec, Portneuf, Montmorency, Levis, Bellechasse, Dorchester, Beauce and Lotbiniere.

HAMILTON.—Application will be made at the next session of the Legislature of Ontario, for an Act to incorporate "The Hamilton and Lake Erie Power Company" with power to acquire the right of way for and construct a water course and raceway from some point on Lake Erie, through the city of Hamilton to Burlington Bay, through the counties of Haldimand, Lincoln, Welland and Wentworth, and to build electrical works in connection with the said water courses and raceway for the purpose of generating electrical energy.

YARMOUTH, N. S.—Notice is given of the application to the Dominion Government for charters to confer power for building and operating electric railways between Yarmouth and New Brunswick. E. Franklin Clements, the applicant, says the idea is to follow the main line of travel from Yarmouth, skirting the shore to Weymouth, thence to Truro, Amherst, and into St. John, New Brunswick. Water power, and in many instances—by means of patented appliances—the tidal waters are to be utilized. The cost of travel, it is claimed, will be fifty per cent. less than on any existing roads.

THE STOCK OF THE MONTREAL STREET RAILWAY COMPANY is gradually going into the hands of investors. Over one thousand shares of the old stock has recently been taken over; 600 by the Society of Jesus of Montreal; 300 by John Breaken, Quebec; and 100 by E. J. Barbeau, Montreal; besides several other smaller lots. James Ross is now the largest individual shareholder in the company, having no less than 6,000 shares to his name, representing over half a million dollars at present market prices. R. B. Angus has 2,500 shares, the Seminary of Montreal 2,000 shares, and Mr. Breaken of Quebec, over 1,000 shares.

OSHAWA, ONT.—Capt. Carter, whose charter for the construction of the Electric Street Railway has lapsed, is after a new charter. He appeared before the City Council and proposed to go on now and commence the construction of the road within ten days, and place a deposit of $2,000 to the credit of Mayor Cowan in the Western Bank here on that date, to be forfeited should the first section be not completed by May 31, but to be returned should the first section be completed and in operation by January 1, 1895. It was decided to further consider the matter at a special meeting of the Council, to be held on Tuesday, 13th inst.

THE EXCHEQUER COURT of Ottawa, has given judgment for the government in the case of the Toronto Street Railway vs. the Crown. This was a custom case arising out of the importation of rails for street railway purposes. At different times in 1891, 1892 and 1893 the Toronto Railway Company imported steel rails weighing 69 pounds per lineal yard to be used in relaying and extending its tracks. On such importations there were paid customs duties (under protest) amounting to $56,000. Action was taken for the recovery of such amount from the Crown. The chief question in the case was "Does the term 'railway' in clause or item 173 of the Tariff Act of 1887, which provides for the free entry of steel rails, weighing not less than 25 pounds per lineal yard for use in railway tracks, include a street railway?" Mr. Justice Burbridge, in the course of a carefully considered and exhaustive judgment, answers this question in the negative. He gives judgment for the Crown with costs.

ENGLISH NOTES.

(From our own Correspondent.)

LONDON, Nov. 2, 1894.

HOUSE WIRING.—The competition for house wiring contracts is extremely keen in this country, every bell hanger, plumber or gas fitter can, by the expenditure of a little paint, add to his already numerous qualifications, that of electrical engineer. It would seem that the severity of this competition is being increased by the cable manufacturing companies entering into the field, much to the disgust of the regular house-wiring firms. Several of our electrical supply companies when they first started business tried the experiment of going in for wiring, but whatever may have been the immediate profit or advantage to themselves, they were soon induced to desist.

CITY LIGHTING.—I hear on good authority that the recent breakdown at the Bankside station of the City of London Electric Lighting Company resulted in a very stormy meeting of the board of directors, and that the contractors concered are likely to have a warm time of it. A daily paper had a paragraph with regard to this breakdown which threw the blame upon the cables, and insinuated that the contract for these had been obtained by improper influence. The outcome of this paragraph is that writs for libel are flying about in all directions. It is in the "City" that the incandescent gas burner is likely to obtain its foremost hold, and it is just in this area that the electric light has of late been misbehaving itself.

News of the Week.

TELEGRAPH AND TELEPHONE.

ABERDEEN, MISS.—J. Herman Soock, Jr., will erect a telephone system, and is in the market for supplies.

CEDARTOWN, GA.—The American Magneto Telephone Company, of Kokomo, Ind., is to construct a telephone system, having obtained a franchise for same.

ELIZABETH, N. J.—The Elizabeth Mutual Telephone Company was organized, and the following directors were elected: F. M. Voorhees, J. M. Grooff, Peter Egenolf, E. R. Brown, George C. Ford and others. The company will at once advertise for bids and the construction of the line through the city will be begun.

MARIETTA, O.—Articles of association have been filed with the secretary of State of West Virginia for a charter for the Union Telephone Company, C. H. Shattuck, president Citizens' National Bank, Parkersburg, W. Va.; G. A. Gilkerson, Internal Revenue Collector; Hon. J. B. Finley, of Parkersburg: A. T Nye, president Citizens' National Bank, and F. S. Shurick, of Marietta, being charter members. Franchises are held in these two cities, and subscribers on five-year contract include practically all the present subscribers of the Bell Company in these two cities. It is expected work will begin on plant at once, and everything will be in as complete order as it is possible to make the same. The make of telephone has not yet been decided upon.

ELECTRIC LIGHT AND POWER.

BUNKER HILL, ILL.—Plans are being perfected for an electric light plant.

FREDERICTON, MD.—Address the Mayor concerning electric lighting contract about to be let.

OSWEGO, N. Y.—The question of municipal ownership of an electric light plant is being agitated.

MARION, O.—The Marion Electric Light and Power Company reports an increase of capital stock from $40,000 to $100,000.

WINTER PARK, FLA.—The Summit Hotel has purchased a 25-kw combined engine and dynamo from the General Electric Company.

LEBANON, ORE.—Lebanon is likely to vote on the question of bonding the town for the purchase of the electric light company's plant.

WILLIAMSPORT, PA.—The Beacon Electric Company has received a contract for lighting the streets of the city. J. Geo. Kaelber is manager.

READING, PA.—At a meeting of the Board of Trade, Mr. Brusher moved that $400,000 be borrowed for a municipal gas and electric light plant.

DULUTH, MINN.—The citizens have voted to issue $600,000 in bonds for the purchase and improvement of the electric plant already in existence.

WILLOUGHBY, O.—Willoughby will vote on the proposition to construct at public expense an electric light plant; $6,000 is the amount asked for.

HACKENSACK, N. J.—The plant of the Edison Electric Light Company has been destroyed by fire. Loss, $30,000. The company will rebuild at once.

WARNELL, FLA.—The Warnell Lumber & Veneer Company, manufacturers of vegetable crates, orange boxes and veneer, will put in an electric light plant.

DETROIT, MICH.—The contract for lighting West Branch with electric lights has been awarded to the Vaughn Manufacturing Company, and the town will have electric lights at once.

DELAND, FLA.—John B. Stetson, of Philadelphia, is organizing a company with a capital stock of $300,000, for the purpose of building an electric light plant, railway and ice plant.

NORTHPORT, L. I., N. Y.—The Northport Electric Light Company is trying to secure a suitable site on which to establish its plant. The people have been promised light by January 1st.

EAST LIVERPOOL, O.—The Ceramic City electric light plant was completely destroyed by fire. The cause was suddenly increased pressure of gas which supplied the boilers. Loss $10,000.

SPRINGFIELD, MASS.—William Boardman Toby and several other prominent electricians have formed a company with a capital stock of $150,000 for the manufacture of motors and other electrical machinery, on which patents are held by Pittsfield inventors.

DAYTONA, FLA.—A company is now considering the capitalization of a combined electric plant to operate a street railway, light the streets and manufacture ice and provide cold storage at Daytona.

PLAINFIELD, N. J.—The North Plainfield Borough Council, being dissatisfied with the quality of its street electric lighting, has decided to employ an expert to investigate the company's alleged deficiencies.

BUFFALO, N. Y.—The LeRoy Hydraulic Electric Company has been granted permission to string wires and erect poles for transmitting electricity for light, heat and power on streets where there are no poles.

PORTLAND, ME.—At the electric light works all the valuable machinery was deluged with water, so that the loss will be $50,000, and perhaps more. The company gives out an estimation of the loss as about $100,000.

RICHMOND, VA.—The Chesapeake and Ohio will build an electric light plant at Richmond, Va., to supply its storage batteries, which are used on its passenger trains for lighting and which are proving a geat success.

CONNEAUT, O.—The Council has entered into a contract with the Conneaut Electric Lighting Company for twenty-five 1,500-cp arc lights, to be erected in different parts of the town. It also passed an ordinance compelling all railroads to erect arc lights at street crossings.

YOUNGSTOWN, O.—The Mahoning county commissioners are talking of putting in an independent electric lighting plant for the court house and jail. It costs at present $528 per year to do this work. They claim an outfit can be had for $1,000 to do the same work more satisfactorily.

BALTIMORE, MD.—A company is being organized to utilize the waters of the Susquehanna River to provide electric power. The plant, it is said, will be established at Coniwingo, 35 miles from Baltimore, from which it will be transmitted by overhead wires, taking in several towns on the way.

NEWTON, MASS.—The question of municipal ownership of a gas and electric lighting plant is being agitated. Mr. Goodrich, of the Newton & Watertown Gaslight Company, is prepared to establish a plant in Newton, and to undertake to do the whole of the street lighting by the incandescent system.

WORCESTER, MASS.—The Trustees of the Home for Aged Women have decided on plans for their new building, which will be lighted probably by electricity. The building committee consists of Augustus N. Currier, C. Henry Hutchins, George C. Whitney, Francis A. Gaskill and Edward P. Tolman.

RYE NECK, N. Y.—A meeting of the property owners to consider the lighting question has been held, and it was decided to petition the town board to make a contract with the Mamaroneck Electric Light Company for 20 or 25 incandescent lights at $18 a light per year. The matter will come up before the town board.

SIOUX RAPIDS, IOWA.—H. D. Smith has closed a contract with the Fort Wayne Electric Corporation, through its Omaha agent, Mr. E. T. Pardee, for a 500-light Fort Wayne alternating dynamo, together with 300-light capacity of the new "Wood" transformer. The plant is to be installed in Mr. Simth's new mill in connection with a new Reynolds-Corliss engine.

LISBON, IOWA.—The city has closed a contract for the new municipal electric lighting plant. The Fort Wayne Electric Corporation through its western agent, Mr. E. T Pardee, of Omaha, gets the contract for a 750 light "Wood" alternator, with the complete electrical construction, and the Buckeye Engine Company, of Salem, Ohio, through their Chicago agent, Mr. H. E. Troutman, got the contract for the steam plant, including a 75-hp Buckeye engine. Work will be commenced at once.

RICHMOND, VA.—Messrs. Wallerstein and Grimes of the committee, and Mr. Maurice W. Thomas, representing the Old Dominion Electrical Construction Company, recently held a meeting. It was suggested by the committee that Mr. Thomas submit at the next meeting a detailed estimate as to the cost of establishing an electric light plant, with water power or steam power. This was agreed to. Mr. Thomas stated that the city of Lynchburg intended to establish an electric plant of their own, and that he had to appear there to submit estimates to the proper authorities.

THE ELECTRIC RAILWAY.

ATLANTA, GA.—The Atlanta Traction Company will extend its lines to the city property.

CHARLESTON, S. C.—The City Council has granted J. Fishburn a franchise to build and operate an electric railroad.

NEW ORLEANS, LA.—The New Orleans Traction Company intends building an electric power plant which is to cost $50,000.

TAMPA, FLA.—R. W. Easley and W. H. Kendrick are arranging to build an electric railway between Tampa and Palmetto Beach.

KANSAS CITY, MO.—The Broadway horse car line of the Metropolitan Street Railway Company will be changed to electricity.

CHICOPEE, MASS.—The Municipal Board has appointed a committee to draw up a franchise for the Holyoke Street Railway Company.

NEW BRITAIN, CONN.—The Central & Electric Railway Company has now fully decided to extend their lines to Hartford and Berlin.

SPRINGFIELD, MASS.—A location for tracks on Bond street has been granted the Street Railway Company. It will start to build at once.

MIDDLETOWN, CONN.—The civil engineers are laying out the lines for the electric railway. They have progressed as far as College street.

OGDENSBURG, N. Y.—The Ogdensburg Street Railway Company has made application to the common council for the operation of its system by electric power.

HENDERSON, KY.—J. N. Alsop, of Owensboro, and others have secured control of the Henderson street railway and propose changing to electric power.

NASHVILLE, TENN.—The Nashville Electric Railway Company's car sheds were recently burned. The property was valued at $20,000, and was partially insured.

BROOKLYN, N. Y.—The Nassau Electric Railway Company, of Brooklyn, is to construct a power station 102x150 feet, which will be built entirely of iron and steel.

LINCOLN, ILL.—The Lincoln Street Railway has been sold for $75,000. Possession will be given at once and an extension of the line will be commenced immediately.

OCONAMOWOC, WIS.—An ordinance is before the Council to grant an electric street railway franchise. Thomas Marston, of the firm of Felix & Marston, Chicago, Ill., is the leading projector.

ATHENS, GA—Application has been made for a charter by the Athens Electric Railway Company for the purpose of operating the Athens Electric Railway, of which T. P. Hunnicutt, is superintendent.

LIGONIER, PA.—The people of Ligonier Valley are much interested in the proposed extension of the electric road to Ligonier. From there to Latrobe, 10 miles, the only outlet is the Ligonier Valley Railroad.

HEMPSTEAD, L. I., N. Y.—The board of trustees held a special meeting to consider the application of the Hempstead Traction Company for a franchise for a surface railway in certain streets in the village.

M'KEESPORT, PA.—An electric road to connect Elizabeth and McKeesport is contemplated. It is also intimated that it may be a new company altogether that is seeking to build the proposed line to Elizabeth.

AKRON, O.—The Akron and Bedford and Cleveland Electric Railway Company has been granted a franchise by the County Commissioners, and work will be commenced April 1. The road is to be completed within one year.

ST. LOUIS, MO.—The City Council and House will be asked soon to grant a franchise to the St. Louis & Southwestern Electric Railway, of which George C. Fox is president, A. E. Weiss, secretary, and J. M. Wiener treasurer.

MIDDLETOWN, N. Y.—At the meeting of the Goshen Board of Trustees a franchise was granted to the Middletown-Goshen Traction Company to lay its tracks through certain streets within the corporate limits of the city.

WESTBORO, MASS.—The Woodville, Hopkinton & Westboro Electric Railway Company is being organized by D. G. Underwood, of Malden, and A. M. Bridgman, of Brockton, Mass. It is stated that $50,000 has been subscribed.

PARKERSBURG W. VA.—W. A. McCosh, superintendent of the Park City Street Railway, has men at work on Seventh street digging holes for the trolley poles for the new electric street railway This is the first step towards the erection of the new line.

LOS ANGELES, CAL.—Prof. T. S. C. Lowe, builder of Pasadena's Mountain Railway, is interested in the extension of the road from Echo Mountain, its present terminus, to the highest summit of Mount Lowe. The extension will be an electric road seven miles in length.

GLOUCESTER, MASS.—The new electric street railway between Gloucester and Beverly will be built, perhaps next spring. The directors are securing the consent of Gloucester and Essex end and with the consent of Beverly and Manchester will be in condition to begin early in the spirng.

WOODVILLE, MASS.—An electric railway is projected between Woodville Hopkinton and Westboro, and $50,000 of the stock has been subscribed. G. B. Underwood, of Malden, and Arthur M. Bridgeman, of Brockton, heavy subscribers to the Marlboro & Westboro line, are interested in the new road.

CINCINNATI, O.—Plans for the foundation of a new generating station, projected by the Cincinnati Street Railway Company, were filed with the Inspector of Buildings. The plant is to be a very large one, designed to furnish power for the operation of the new line on Hamilton avenue to College Hill.

RUTLAND, VT.—The extension of the fair ground branch of the electric street railroad through "Nebraska" by way of the Pine street tunnel will not be built until next spring. It is stated on good authority that estimates are being made for the extension of the West Rutland line to Lake Bomoseen.

NORTH ADAMS, N. Y.—The electric street railway from North Adams to Williamstown through Braytonville, Greylock and Blackinton, seems to be an assured thing, work to commence early next spring. The Hoosac Valley Street Railway Company, backed by strong local capitalists, will build and operate the road.

READING, PA—Efforts are being made to build an electric railroad from Reading to Allentown. The various supervisors of the township through which the road is to be built have been approached. It is said that it is to be an extension of the Reading & Temple Electric Railway and is to enter Allentown on Walnut street.

EAST BOSTON, MASS.—R. W. McIntyre, of New Haven, Conn., has been awarded the contract for the construction of the new terminal facilities, of the Boston, Revere Beach and Lynn railroad at East Boston. The work will include building new freight house, docks, ferry houses, electric coal pocket, etc., and cost over $100,000.

AKRON, O.—The County Commissioners granted the Akron, Bedford & Cleveland Electric Railway a franchise allowing the use of the Bedford pike for railroad purposes. The company is to keep bridges and culverts in repair and pay the county $300 annually for tweny-five years. It is expected that work will be commenced on the line at once.

PIKESVILLE, PA.—Geo. R. Webb, vice-president and manager of the Pikesville & Emory Grove Electric Railroad Company, and J.M. Widderdorf, banker, were in Hanover to consult business men concerning the extension of the road to Hanover. Mr. Webb says if the people along the line between Hanover and Manchester will raise $150,000 the road will be built.

CHAMBERSBURG, PA., is agitating for a trolley line and public park. But $20,000 more is needed to start the enterprise. Among contemplated extensions and spurs are a line to Fayetteville, Mount Alto and Waynesboro with a proposed extension to the Blue Mountain summer resorts, an extension through the streets of town and a spur to the C. V. R. R. passenger station.

JERSEY CITY, N. J.—The Consolidated Traction Company wants to extend its West Avenue line down to Greenville. It is making arrangements to do this. President E. F. C. Young, General Manager David Young, Mr. John Crimmins and other officials of the Consolidated Traction Company and the New Jersey Central Railroad Company, have made visits to West Bergen and thoroughly examined the ground.

MILTON, ONT.—The Hamilton Radial Railway Company, William F. Forsythe, president, bought out the Niagara Central Railway for $400,000. The Hamilton Radial Company will extend its lines thirteen miles from Niagara Falls to St. Catherines, the first part of its radial system. Surveyors are at work on the line between this city and St. Catherines. The first work will be to build the road into this city.

EUREKA SPRINGS, ARK.—It is stated that surveys will soon be commenced under the direction of F. L. Hamilton, of Harrison, Ark., for building the proposed electrical railway from Eureka Springs via Green Forest to Harrison. The distance is forty-five miles, and two bridges, one 204 feet and the other 504, will be required. A syndicate of Chicago capitalists, with Dr. E. C. Harris as manager, is said to be back of the project.

BEREA, O.—The Cleveland & Elyria Electric Railroad Company, with headquarters at Berea, filed articles of incorporation. The route of the proposed road is from Cleveland through the counties of Cuyahoga and Lorain to Elyria, with branches to Wellington and Oberlin. The capital is $2,000,000, and the incorporators are E. T. Pomeroy, M. A. Sprague, A. W. Bishop, C. W. D. Miller, W. M. Cole, Will Christy and A. H. Pomeroy.

COLUMBUS, GA.—The Columbus Railway Company, Mr. Furnoy president, has closed a contract with the Philadelphia Railway Construction Company for the electrical equipment of its road. The equipment is to consist of twenty 200-kw generators, 20 G. E-800 motors forming 10 double equipments with Form K. controllers. The line equipment is for 14½ miles single track and 2½ miles double track. General Electric apparatus will be used.

JACKSONVILLE, FLA.—J. H. Sherman, as chairman, has received from Geo. W. Haines, superintendent of the Jacksonville Street Railway Company, a reply to a petition of the residents of West Campbelltown, West Brooklyn and West Louisville, asking that the street railroad be extended through Myrtle avenue into the suburbs named. Mr. Haines says that he cannot give a definite answer at present, as the matter of extension of the service is being now arranged.

LINCOLN, ILL.—Mr. W. H. Patterson, manager of the street railway lines of Bloomington, Ill., has purchased the lines at Lincoln, paying $75.000 for the same. The Bloomington company has taken possession of the property, and one of the first things it intends to do is to greatly improve the system. At present there are six miles of railway in the city, and Mr. Patterson will make it a belt line, with a 15-minute service. Mr. Lewis Senseney, now connected with the lines here, will be made manager.

HAMILTON, ONT.—The Hamilton Electric Radial Railway, Wm. F. Forsyth, president, has bought out the Niagara Central Railway for $400,000, to be paid to Dr. Oille, Mr. Sylvester Neelon and the other owners of the road. The Hamilton Radial Company will make the 13 miles of road from Niagara Falls to St. Catharines, the first part of its radial system. Mr. Forsyth started a lot of surveyors on the line between this city and St. Catherines. The first work will be to build the road in this city.

MILTON, N. Y.—At a meeting of the Highway Commissioners a petition by Fred R. Barnes was read, asking the Board to grant a franchise for the construction of an electric road through the public highways of the town from this village to Rock City Falls. Another petition from S. C. Medbury and Herbert C. Westcot was read, asking the Board to grant them a franchise over the same route. Mr. Barnes appeared for the construction company. The Board decided to grant the franchise to Mr. Barnes.

MUNCIE, IND.—The Citizens' Street Railway Company has in the past ten days added one mile additional trackage to its lines. Another additional half mile is now being constructed, making in all over sixteen miles of trackage. The power capacity of the road has been increased one-third in the past thirty days, making the line one of the best equipped in the country for a city of 25,000 population, and all has been built and constructed in the period of eighteen months from the date of driving the first spike. Over one and three-quarters miles of this trackage is laid with 86-lb. Johnson's improved groove rail in asphalt streets, which has been laid and streets made in the past sixty-five days.

MISCELLANEOUS NOTES

THE GENERAL ELECTRIC COMPANY has advertised for plans and specifications for two new buildings to add to their extensive plant in Schenectady, for storerooms and laboratory.

THE STANDARD UNDERGROUND CABLE COMPANY has brought suit at Pittsburg against Geo. Westinghouse, Jr., in which it is alleged that certain stock turned over to the latter has not been properly applied, and an order of the court is asked compelling an accounting for the same.

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS will hold its second general meeting at 12 West Thirty-first street, November 15 and 16, and members of the American Institute of Electrical Engineers have been cordially invited to attend. Among the papers to be read of especial interest to electrical engineers is one by S. Dana Greene, Esq., on "Electricity on Shipboard; Its Present position and Future Development." Another paper by Naval Constructor W. J. Baxter, U. S. N., will describe an electrical method by means of which the launching speed of the battle ship "Texas" was determined.

THE PACIFIC CABLE.—On November 9 proposals were opened at Ottawa, Canada, by the Minister of Trade and Commerce, from six different firms for laying a Pacific cable. The firms are the Fowler-Waring Cable Company, the Telegraph Construction and Maintenance Company, Messrs. Siemens Bros., the W. T. Henley Telegraph Works Company, Francis A. Bowen, and the India Rubber Gutta Percha and Telegraph Company, all of London. The propositions were all considered by the Minister as favorable, and as removing every obstacle that has been urged against the enterprise.

SMALL BOYS AND A MOTOR CAR.—Last week, at Newark, N. J., according to a local paper, two small boys, aged about 6 years, "with their several mashes, two little girls," took possession of a vacant motor car, and though the trolley was disconnected and the controller lever had been taken off by the motorman, they nevertheless succeeded in starting up the car. While one youngster put on the trolley the other by means of a piece of shingle inserted in the slot of the controller shaft, turned on the current. As the speed increased, however, the enterprising quartette became frightened and leaped off, and the car finally jumped the track and brought up against a telegraph pole.

Trade and Industrial Notes.

GOVERNMENT CONTRACTS.—The following awards have been made for furnishing the Weather Bureau with telegraph supplies for the fiscal year ending June 30, 1895:

Bishop Gutta Percha Company, New York, 300 feet each, wire, braided, Okonite insulation, Nos. 14, 16, 18, Birmingham gauge, 7-32 insulation, 2¼ cents, 2 cents, 1¾ cents.

The National Electric Manufacturing Company, Milford, Conn., 150 con-

nectors, single, 5 cents each; 15 keys, telegraph, Bunnel pattern, top connections, 95 cents each; 10 ditto, bottom connections, 95 cents each; 15 relays, box soundings, with keys, 150 to 200 ohms, $4.50 each; 20 sounders, telegraph, giant, $1.35 cents each.

The E. S. Greeley & Co., New York, 300 connectors, double, 8½ cents each; 2,500 insulators, screw, glass, 2¼ cents each; 150 pounds sal-ammoniac, 6¼ cents; 50 syringes, battery, hard rubber, No. 6, $1.40 each; 10 vises, hand, 5½ inch, with straps, $1.12½ each; 50 pounds each copper wire, office, Phillips' braided water-proof, Nos. 20 and 22, 23 cents.

W. R. Brixey, New York, 12 rolls tape, Kerite, 57 cents; 1,000 feet copper wire, No. 16, B. W. G., 3 conductor cable, 7½ cents; 1,000 feet ditto, No. 16, B. W. G., 1 conductor cable with braided covering, 2½ cents; 5,000 feet ditto, insulated, 2 conductor, No. 18, B. W. G., 4½ cents; 500 feet ditto, Nos. 16 and 18, B. W. G., 9 conductor cable, 18½ cents; 500 feet ditto, 6 conductor cable, 13 cents.

Royce & Marean, Washington, D. C., 30 batteries complete, Leclanche-Gonda prism, small, with sal-ammoniac, 70 cents each; 30 ditto, large, with sal ammoniac, 70 cents each; 9,000 pounds blue vitriol, packed in barrels, 3⅝ cents; 7,000 pounds of blue vitriol, packed in 50-lb. boxes, $1.82 per box; 3,000 brackets, insulator, 2 cents each; 150 brushes, battery, bent handle, 25 cents each; 3,000 coppers, gravity battery, 5x7 inch, 4½ cents each; 600 jars best flint glass, gravity battery, 10 cents each; 50 pliars, Stubs', side cutting, 8-inch, $1.42 each; 60 ditto, 5-inch, 63 cents each; 200 porcelain insulators, No. 4, 1 cent each; 20 switches, wooden base, 2 point, 15 cents each; 50 telephone cords, 15 cents each; 4,000 zincs, crowfoot, for gravity battery, 5x7 inch, 11½ cents each; 75 ditto, for Leclanche-Gonda prism battery, 5 cents each.

FRANK H. STEWART, Philadelphia, importer, manufacturer and dealer in electrical supplies, owing to increase of business, has taken larger quarters at 20 North Seventh street.

THE MATHER ELECTRIC COMPANY, Manchester, Conn., have been awarded the contract for furnishing dynamos for the new Library of Congress building at Washington, the price being $6,400.

THE OAKMAN ELECTRIC COMPANY, 136 Liberty street, is making a special drive in Partridge Carbon Brushes and McNutt incandescent lamps for street railway service, for which it is New York selling agent.

E. G. SMITH, Columbia, Pa., in a 16-page catalogue, describes a line of modern measuring instruments for trades, scientific purposes, etc. Among the specialties are all kinds of calipers and metric scales, screw-micrometers, for laboratories, etc.,

S. E. WHITEHEAD, Carthage, Mo., reports an increasing demand for the Eddy self-locking windlass in excess of supply. He has just completed a shipment to Jamestown, N. Y., of one hundred and thirty widlasses and has a large number of inquiries and orders.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is hard at work upon its catalogue of electric railway supplies, and hope to have it ready for distribution in a few weeks. They promise to list a very desirable line of electric railway material, including the "Lynn" specialties.

THE PARTRICK & CARTER COMPANY, 125 South Second street and 131 Gothic street, Philadelphia, are now the sole selling agents for the Applegate electric matting. This matting will hereafter be made in three standard widths, two, two and a half and three feet, each roll being about 50 feet long.

THE SHAWMUT FUSE WIRE COMPANY, 161 High street, Boston, has issued a new edition of its pamphlet on fuse wire and fuse links. Besides being a catalogue, this handsome brochure also partakes of the character of a technical treatise on the subject, and therefore interests everyone who in any way has to do with fuse wire.

THE FORT WAYNE ELECTRIC CORPORATION, Fort Wayne, Ind., has closed a contract with the city of Lisbon, Iowa, through their Wester nagent, E. T. Pardee, for a municipal lighting plant, consisting of a 750-light Wood alternator, with a complete electrical equipment. Also with H. D. Smith, of Sioux Rapids, Iowa, for a 500-light Fort Wayne alternator, together with 300 light capacity of Wood transformers.

J. B. PHILLIPS, electrical engineer and contractor, 30 Cortlandt street, New York, has recently closed a contract for wiring Troop A Armory, 94th to 95th street, this city, for 1,000 lights. Mr. Phillips has just completed the installation of the Standard Silk Company's plant, of Phillipsburg, N. J.; this contract of 560 lights, Wenstrom dynamo and rearrangement of all the circuits, 1,500 lights in all. Mr. Phillips has moved his office from 40 to 30 Cortlandt street.

THE LINK-BELT MACHINERY COMPANY, 21 South Jefferson street, Chicago, has issued a handsome pamphlet entitled "Modern Methods of Handling Fuel as Practised in Locomotive Coaling Stations, Electric Light and Street Railway Power Plants, etc.," in which a large number of coaling plants installed by this company are illustrated, as well as others in which it has installed the "Standard" water tube safety boiler, rope transmissions, etc.

J. GRANT HIGH & CO., 123 North Third street, Philadelphia, Pa., have just opened up a branch office in Room No. 807 Medinah Temple, Chicago, where they will be pleased to see their patrons, and expect to do an extensive business in their line. This enterprising firm of young men has met with flattering success in the East, where their switchboards particularly have been highly appreciated by electrical engineers and installed in many notable plants.

THE PROCTOR-RAYMOND ELECTRIC COMPANY, Rochester, N. Y., has been having much success with its "Eclipse" and "Rex" bells, and the "Eclipse" annunciator. It is the intention of this enterprising firm to manufacture the most complete line of electric bells and house furnishing electrical goods of any concern in the business. To this end the highest grade of material is used, and such care bestowed in construction and on workmanship that liability of any of the apparatus to get out of adjustment will be impossible.

HOLTZ, FEY & BLOOMER, 630 Mission street, San Francisco, Cal., have succeeded to the firm of Holtz & Fey, Mr. J. G. Bloomer, late manager and for eleven years with the California Electrical Works, being the new member. Mr. Theodore F. Holtz was for ten years superintendent of the factory of the California Electrical Works, with which Mr. Charles Fey was also formerly connected—in the electro-mechanical department. The factory of the new firm has been removed to the above address, where it has also opened a store for a general electrical supply business.

THE PURITY OIL FILTER MANUFACTURING COMPANY, 90 Water street, Pittsburg, Pa., recently received the following orders for oil refiners for electrical plants: From its San Francisco, Cal., sales agent, D. W. Doubs, for 13 Purity and Ideal refiners; Municipal Electric and Water Department, North Attleboro, Mass., one Ideal refiner; Rockville (Conn.) & Ellington Street Rail way Company, one Ideal refiner; National Cotton Oil Company, Galveston, Tex., one Ideal refiner; Pittsburg, N. I. & Coraopolis Street Railway Company, one Ideal refiner; James Beegs, New York, one Ideal refiner; Thomson-Houston International Electric Company, New York, four Ideal refiners; Cairo (Mich.) Electrical Works one Ideal refiner; Home Bank Building, Detroit, Mich, one Ideal refiner.

THE BALL ELECTRIC LIGHT COMPANY, of New York, has just installed under the supervision of F. Widmayer, a 65-arc light plant at the leading dry goods store in Pittsburg, Pa., Campbell & Smith, Fifth avenue. The above firm have been using two 2 26-light arc dynamos of the Ball system for the past six or seven years and have lately increasd their plant by a new dynamo. This new dynamo is attracting great attention in Pittsburg, as it is the first of its kind in that locality having a very unique and original method of regulation. It has practically two independent automatic end frames. The regulator is most simple and effective. The machine is fitted up with self-oiling bearings and has all the latest improvements that can be applied to a high tension arc dynamo. Mr. Scobie, the engineer in charge, takes great pleasure in showing this dynamo to all who are interested in arc lighting.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has issued a very complete catalogue of electric street railway supplies, containing no less than 204 large octavo pages, being probably the most exhaustive trade publication devoted to this branch ever printed. The book is a companion volume to its similarly exhaustive catalogue of general electrical supplies, and together furnish an admirable illustration of the enormous extent of the electrical industries. It is needless to say that every imaginable material used in connection with the construction and operation of street railways is here contained, only excepting the power-house and motor car machinery. The entrance of this enterprising firm in the electric railway field is fittingly announced in this manner, and with a wider scope thus opened for its energies it will give a still further impetus to the supply branch of the electrical industries. Another useful publication by the same firm is a pocket catalogue of insulators, which contains handsomely lithographed sheets of every variety of porcelain insulators.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., has received a flattering testimonial from H. S. Cooper, general manager of the Schenectady Street Railway Company, in which he states that on May 10 an open-air car was equipped with steel pinions, and on May 28 the same car was equipped with raw hide pinions. On October 6 the steel pinions were worn out and had also worn out the axle gears in which they mesh, while the raw hide pinions are not nearly worn out and the axle gears in which they mesh are not worn at all perceptibly. Both these cars have run steadily over identically the same route and have carried very closely the same number of passengers an average the same mileage, 100 miles per day. The road is a very hard one on gears, as it is all curves and grades, with the curves all on grades 6, 7½, 10 and 12 per cent., and some of them pretty long ones. The writer says he is well pleased with the results, the more especially as he was somewhat dubious at first as to the using of raw hide on single reduction machines, although his experience with them on double reduction had been very satisfactory.

THE GENERAL ELECTRIC COMPANY has secured one of the largest contracts for furnishing motors and generators ever awarded, signed on Nov. 2 by Mr. Charles T. Yerkes, to supply the North Chicago Street Railway Company and the West Side Street Railway Company with electrical power. The contract at the start calls for the delivery on or before March 1, 1895, of 600 motors and 3,600 horse power in generators, at which time Mr. Yerkes expects to have his power house ready to start the different lines. It is the intention of Mr. Yerkes to equip all his traction system in Chicago with electricity, and the contract is said to call for the General Electric Company to supply the same. The present contract amounts to over $500,000, and it will in all probability amount to about $4 000,000 before Mr. Yerkes has completed his system, as he controls virtually all the railroads, both surface and elevated, in Chicago, with the exception of Capt. R. Somers Hayes' West Side Metropolitan Company. The motors and generators will be delivered subject to order, and all the cars equipped with them so as to be ready when the power houses are completed. The General Electric Company has now on its pay roll at Lynn and Schenectady about 4,700 men, and the force will have to be increased considerably to fill the contract, besides other large ones that have been lately secured. During the month of October the General Electric Company sold about 800 motors and generators of different styles, which amounted to about $700,000 in value.

H. D. BAYNE & COMPANY, Mutual Life Building, New York, are among the most recently organized combinations for carrying on the business of consulting engineers and electrical contractors. The technical matters in all work undertaken by the firm will be under the direct personal supervision of Mr. H. D. Bayne himself. His connection with the electrical business dates as far back as the year 1876, and his work then in the employ of the old Jablochkoff company, of Paris, France, brought him into contact with the leading men of their time in electrical matters, such as Jablochkoff and Gramme. Since those days he has had extended experience with the following firms: Jablochkoff Electric Light Company; Ball Electric Light Company; Thomson-Houston Electric Company; United Edison Company and General Electric Company. For these companies he has superintended the construction of apparatus in England, Scotland, Ireland, Spain, France and Belgium; and out of Europe, in the United States, Canada, Mexico, Yucatan, Guatemala, Venezuela and Cuba. Such an unusually wide experience will no doubt be a guarantee of success to the new enterprise in what they propose to make their speciality, viz.: Artistic electric lighting, transmission of power and railroad work. Mr. Bayne is the patentee of several electrical appliances. Mr Bernard Eekhout, son-in-law of Mr. James McNamee, of this city, and late senior of the firm of Eekhout, McLean & Company, of Baltimore, is manager for Mr. Bayne, and will conduct all financial and general business matters of the firm.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

TO WHOM IT MAY CONCERN.—Take notice that the co-partnership existing under the firm name of Bradley & Combs, doing business at Rochester, N. Y., has been mutually dissolved.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 6, 1894.*

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York.)

528,529. PLUG FOR ESTABLISHING ELECTRICAL CONNECTIONS: C. W. Brown, Montreal, Canada. Application filed January 16, 1894. A plug having a body portion tubular in cross section, to be inserted in a correspondingly shaped socket, and having one or more integral flexible expanders normally projecting beyond the periphery of the tubular body portion.

528,539. RHEOSTAT; J. C. Fyfe, Chicago, Ill. Application filed April 27, 1894. The combination with a stationary support of a wheel or cylindrical arcrupturer arranged to rotate on the support.

528,561. TROLLEY WIRE CLIP; J. W. Perry, Philadelphia, Pa. Application filed May 5,1894. A wire clip formed in two parts with a wire pocket between them, one part having a tread curved from end to end on the bottom and the other part removably held to the first part so that they will bite the wire between them.

528,566. COMBINED MUNICIPAL TELEGRAPH AND TELEPHONE SYSTEM; H. M. Seitzinger, Wilkesbarre, Pa. Application filed May 2, 1894. This comprises a central station and main line, sub-stations upon separate circuits, a switch to connect the main line with the separate circuits, and an operating lever for the instruments at the sub-station operated by the movement of the switch.

528,589. ELECTRIC BURGLAR ALARM; W. A. Brownell, Boston, and J. B. Seager, Hancock, Mich. Application filed January 31, 1894. This comprises a door, electric circuit, alarm, and two pairs of circuit closers, all being in series in the circuit when in connection, one pair of closers being in the lock and adapted to be connected by the bolt when extended, and the closers of the other pair being respectively on the door and door frame, and adapted to be connected when the door is open or ajar.

528,590. TELEPHONE EXCHANGE SYSTEM: W. Childs, Fort Smith, Arkansas. Application filed May 27, 1890. A switching instrument comprising a series of concentric circular paths, one or more deflecting flanges, a traveling switch and electrical propelling devices to move the switch.

528,591. TELEGRAPHIC AND TELEPHONIC EXCHANGE SYSTEM. W. Childs, Fort Smith, Arkansas. Application filed May 27, 1890. The combination of a revolving electrode switch, a spring to operate against the switch, a ratchet and pawl controlling the spring, and electro-mechanical devices to revolve the switch in a convolute pathway.

28,592. TELEPHONY; F. R. Colvin, New York, N. Y, Application filed July 26, 1894. This comprises a plurality of stations connected in multiple-arc relation to the line, each station being provided with a high potential calling generator and a talking outfit organized to impose on line low potential talking currents.

528,593. RAILWAY SIGNALLING SYSTEM; M. Corrington, New York, N. Y. Application filed December 3, 1891. The combination of a spaced dial, a pointer moving over the same, and a train actuated mechanism for mechanically imparting to the pointer a determinate advance movement successively by the automatic action of each one or more trains in passing beyond a signalling point.

528,615. SWITCH OPERATING MECHANISM FOR HOISTING MACHINERY; A. J. Shaw, Muskegon, Mich. Application filed June 7, 1894. In combination with two independent electrical switches, an operating lever common o both, and adapted to move both together and either one alone.

528,620. ELECTRIC HOISTING MACHINERY; A. J. Shaw, Muskegon, Mich. Application filed June 25, 1894. In combination with electric hoisting machinery, a magnetic brake for controlling the same, a stop or detent to limit the action of the brake, and an electromagnet included in circuit with the hoisting motor and serving to control the position of the stop or detent.

528,635. MAGNET; Adrian H. Hoyt, Penacook, N. H. Application filed March 14, 1894. A permanent magnet composed of a bar of steel provided with a substantially circular opening and having its magnetic poles at opposite sides of and substantially surrounding the opening.

528,640. TELEPHONE; W. C. Lockwood and J. M. Lockwood, Brooklyn, N. Y. Application filed June 14, 1894. The combination with an open end inwardly flanged shell or jin casement, an axally bored plug partly of wood and partly of solid carbon, of a carbon electrode secured upon a screw, a surrounding of broken carbon for said carbon electrode and a variable air space between said plug and the solid carbon electrode.

527,647. STORAGE BATTERY; C. J. Reed, Philadelphia, Pa. Application filed June 5th, 1894. A positive storage battery electrode of grooved form surrounded by a perforated envelope not readily attacked by the battery liquid, in combination with a negative electrode which surrounds or envelopes the positive electrode and the perforated envelope and holds all of the parts firmly together.

528,648. STORAGE BATTERY; Chas. J. Reed, Philadelphia, Pa. Application filed June 8th, 1894. In an accumulator a solution of a cadmium salt in combination with two electrodes, the positive electrode containing a compound of lead.

528,669. GALVANIC BATTERY; M. M. Hayden, New York, N. Y. Application filed Feb. 21, 1894. In a galvanic battery, a porous cup provided with internal screw threads at the top for containing a depolarizing agent, a screw threaded plug therefor, and a vent channel through said plug.

528,672. CIRCUIT CLOSER; H. J. Hovey, Oak Park, Ill. Application filed Dec. 26. 1893. A circuit closer having in combination the electric contacts or terminals, a series of independently depressible plungers arranged to be depressed by an object moving lengthwise of the series, a deflectable portion arranged under the lengthwise of said series and adapted to be impinged and deflected by said independently depressible plungers, and means at one end of said depressible portion for communicating the movement thereof to said contacts.

528,684. ELECTRIC ARC LAMP; C. E. Ongley, New York, N. Y. Application filed Feb. 17th, 1894. The combination with a search light or projector body, of an extension thereon, an arc lamp in said extension and having pivoted carbon carrying arms extending into said body in front of a reflector, and means for moving the arms to maintain the arc.

528,685. TROLLEY CATCHER; A. S. Osborn, Rochester, N. Y. Application filed May 9th, 1894. The combination with a trolley arm and its operating cord, of a spring-operated shaft, a winding head of forked form attached thereto, a fixed ratchet, a spring-operated detent sliding on the shaft and engaging with the ratchet, a cord-holder pivoted to the end of the shaft opposite the winding head whereby the cord can wind on the latter, and a connection between the cord-holder and detent whereby the latter is disengaged from the ratchet when the cord-holder is raised.

528,740. SECONDARY BATTERY; E. M. Poston, Springfield, O. Application filed Jan. 29, 1894. A secondary battery consisting essentially of a series of sections, each of said sections comprising an outer casing, porous division walls in said casing, metallic plates or walls to form positive and negative electrodes at the respective ends of said casing, an elecrolytic fluid between said porous walls, active material arranged between the respective porous walls and the electrodes, and means for connecting said sections together.

528,744. INSULATING COMPOUND: Oscar Stiles, Omaha, Neb. Application filed March 26th, 1894. As a new insulating compound, the combination of six parts of alcohol, three parts of shellac, three parts of asbestos and one part each of mica and alum, all combined as and for the purpose set forth.

528,767. TROLLEY LINE BREAKER; C. H. Dey and J. M. Anderson, Boston, Mass. Application filed Feb. 16, 1894. In a trolley line breaker or insulating joint, a double insulation consisting of two insulators provided with internally screw threaded bonnets or sleeves,a coupling piece provided with screw-threaded arms with which said internally screw-threaded bonnets or sleeves engage and a cushioning material interposed between the arms and insulator and between the insulator and its bonnet.

528,778. ELECTRICAL TRANSFORMER; R. M. Hunter, Philadelphia, Pa. Application filed April 6th, 1894. In an electrical converter the combinatio of the coils thereof insulated with a wrapper of porous fibrous material, and inclosing case hermetically sealing the coils, an atmosphere within the case and surrounding the insulated wires free from moisture, four or more terminals from the coils within the case extending to without the same, and the moisture proof seals sealing the outlets for the terminals.

528,788. BOND FOR ELECTRIC RAILWAYS: H. B. Nichols and F. H. Lincoln, Philadelphia, Pa. Application filed September 20, 1894. This comprises a rail provided with an opening, a bonding wire, nuts engaging therewith and provided with flanges engaging the openings of the rail, one of the nuts provided with a pour hole to permit of moulten metallic material being introduced into the same so as to expand and establish an air and water-tight connection of the rail with the bonding wire.

528,870. APPARATUS FOR MEASURING ELECTRICITY, W. Friese-Greene, London, England. Application filed March 28, 1894. In an apparatus for measuring electricity, the combination of a core or solenoid located in the main circuit, a fixed and movable rod adjacent to said solenoid, a curved arm on said movable rod provided with teeth at its outer end, a solenoid provided with a plunger, clock-work mechanism for operating said plunger, a bar provided with a stud adapted to slide on said curved arm, the stud meshing with the teeth, and the bar being operated by the plunger.

528,881. ELECTRIC LEAK-ALARM; Chas. C. Kahne, A. A. Adkins, W. S. Pierce, J. E. Martin and G. F. Kahne, Ashland, Ky. Application filed July 6, 1894. In an electric leak-alarm, the combination of a box, having a movable cover, a float working in said box, the contact plate attached to said cover above the float, and an upwardly projecting contact post carried by the float and adapted to be raised against the plate; said plate and contact post being connected with the respective terminals of an alarm circuit.

528,893. RHEOSTAT; Alton J. Shaw, Muskegon, Mich. Application filed April 10, 1894. A resistance device consisting of a band of ribbon of conducting material, crimped or folded facewise, and then coiled edgewise.

528,894. RHEOSTAT; Alton J. Shaw, Muskegon, Mich. Application filed April 10, 1894. A rheostat consisting of a series of blocks provided with atera contact plates, a series of folded conducting strips interposed between the blocks and connected therewith in series, and a movable contact adapted and arranged to sweep the contact plates.

528,900. ELECTRIC SWITCH.; Frank G. Bolles, Washington, D. C. Application filed March 27th, 1894. In an electric switch, the combination with a clamping device for tightening the hinge joint of the movable contact, of a similar device for tightening the contact between the switch terminals, and means for operating them simultaneously.

528,902. MEANS FOR MULTIPLEX TELEGRAPHING BETWEEN CARS OF RAILWAYS; Aaron Fryer, Bath-on-Hudson, N. Y. The combination with a line wire which is supported parallel with a track of a railway and relatively at a side of the same, two cars distant from each other and on the same track, and having, each a trolley arm under control of an operator and pivoted to it, a horizontal spindle carried by the arm, a trolley wheel loosely mounted on the spindle for contact with the line wire, a tension spring between the trolley arm and car for holding the trolley wheel in contact with the line wire,while either or both cars are moving, a telegraphing or signaling apparatus and the wire for connection of the spindle with the apparatus,whereby signals may at will be had between cars

528,907. RHEOSTAT AND HEATER; Robert C. Mitchell, New York. Application filed Jan. 17th, 1894. The combination in a heater of a metal base, the resistance wire with the perforated sheet of non-fusible insulation interposed between the base and wire with a covering of insulating substance

*Owing to the Patent Office mail being held for fumigation, the patent specifications this week and last arrived too late to have the usual illustrations made.